ENERGY REVIEW
NEWFOUNDLAND AND LABRADOR

GOVERNMENT OF
NEWFOUNDLAND AND LABRADOR

Department of Natural Resources

December 1995

103-04141/

ENERGY REVIEW

NEWFOUNDLAND AND LABRADOR

Published under the Authority of

The Honourable Rex Gibbons, Ph.D., P. Geo.
Minister of Natural Resources

Prepared by the Energy Branch

GOVERNMENT OF
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EXECUTIVE SUMMARY

Each year Newfoundlanders and Labradorians spend in excess of $1.5 billion on energy. This is equivalent to about 1/6 of provincial Gross Domestic Product (GDP). Two-thirds of this is for imported petroleum products, either directly for gasoline, heating oil, etc., or indirectly for heavy fuel oil used to generate electricity. In addition, the province exports in the order of 95 to 110 petajoules (26,000 to 30,000 gigawatt hours) of electrical energy to Quebec annually.

The purpose of this report is to provide a detailed review of the province's energy sector. It is intended that the information presented be of use to a wide cross-section at the international, national, and provincial levels, including the energy supply industry, government departments and agencies such as Natural Resources Canada and the National Energy Board, those involved in environmental planning and assessment, and other interested groups and individuals.

Six major subject areas are discussed, namely; (1) Energy Demand, (2) Energy Supply, (3) Energy Efficiency, (4) Energy and the Environment, (5) Energy Prices, and (6) Oil and Gas.

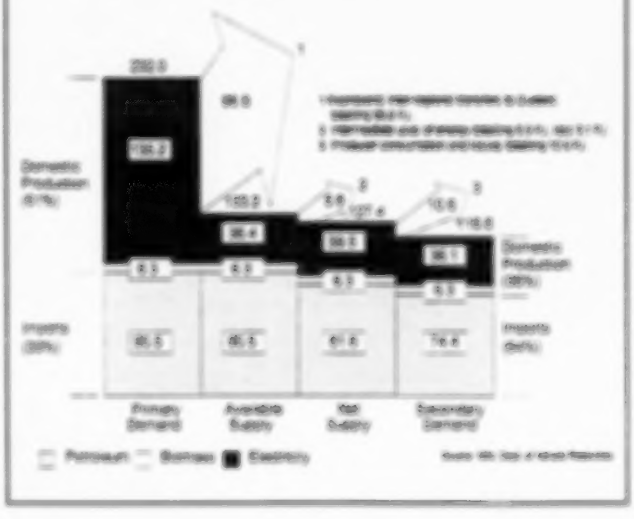
Energy Demand

Figure 2.1 illustrates the sources and disposition of Newfoundland's energy flows, showing the relationship between energy production, exports, imports, primary energy demand, and secondary energy demand.

The province is shown as producing 61 percent of its primary energy requirement with the remaining 39 percent sourced through imports of petroleum products, including small amounts of coke and coal.

It is noted that petroleum required as an input to the refinery process at Come By Chance is imported, and virtually all petroleum products produced at the refinery are destined for export markets. Also, because of data limitations resulting from confidentiality concerns, complete data for the Come By Chance operation could not be published. For these reasons, this review does not detail the refinery's import needs or exports.

Figure 2.1
NEWFOUNDLAND ENERGY FLOWS - 1994
(petajoules)



Executive Summary

The figure shows the overall 1994 demand for energy from Newfoundland and Labrador as totalling 232.0 petajoules, of which, 98.8 petajoules (42%) was exported to Quebec as inter-regional transfers.

To arrive at the amount of energy available for final consumption (secondary energy demand) it is necessary to adjust domestic primary energy demand (available supply) to account for the energy used by the energy supply industry. Energy supply industry use represents fuels used and losses incurred in production, processing, transportation and distribution as well as conversion losses in electricity generation when coal, gas, and oil are transformed as intermediate fuels into electricity. Thus, accounting for energy supply industry use, 133.2 petajoules is required to supply the province's 116.8 petajoules of secondary end use demand. When adjustments are made for both exports and supply industry use, the province needs to import in the order of 64 percent of its energy requirement.

The Newfoundland primary and secondary energy demand figures for 1993 and 1994 are further compared in Table 2.1 (see page T2). This table shows the year to year percentage change and provides demand estimates in terms of both petajoules (PJ) and barrels of oil equivalent (BOE). The BOE estimates are shown in order to provide a point of reference to a more familiar energy measure. In this context, one could interpret the 77 million barrels equivalent figure for 1994 as between one and one half and two times the total expected annual peak production from Hibernia.

The overall 9.8 percent primary energy demand decrease from 1993 to 1994 is primarily explained by decreased supply industry use and reduced transfers of electricity to Quebec. The reduction in supply industry use resulted from a decrease in demand at the Holyrood thermal generating plant, and decreased manufacturing at the Come By Chance oil refinery, which was inoperative between April 24th to the end of October. The refinery resumed full production in November, employing in the order of 400 people.

The 8.3 percent reduction in electricity transfers to Quebec by CF(L)Co was caused by below average precipitation levels and inflows into Labrador reservoirs.

A comparison of 1993 and 1994 secondary energy demand is presented in Table 2.2. This table shows total secondary energy demand as virtually unchanged, increasing only by 0.3 percent, from 116.5 petajoules in 1993 to 116.8 petajoules in 1994. Decreases in residential, commercial/institutional, and transportation sector demand, plus a 5.0 percent decrease in non-energy products demand, were offset by the increased energy demand in the industrial sector. In summary, while electricity demand increased by 2.4 percent, the demand for wood and petroleum products decreased by 2.3 and 2.5 percent, respectively. Coke and coal demand increased by 73.7 percent, due to its increased usage in the mining sector.

Figure 2.3 illustrates petroleum products as the greatest energy source by fuel type, representing approximately 60.0 percent of total demand. This is explained by their heavy usage in the transportation sector. From a sectoral demand point of view, transportation, lead by motor gasoline, is the primary energy user. Following transportation, the industrial and residential sectors are the major energy users of petroleum products.

Energy Supply

Newfoundland and Labrador enjoys an overall energy surplus position. As was shown in Figure 2.1, in 1994 Newfoundland and Labrador produced 141.5 petajoules and consumed 133.2 petajoules. This position is helped by the province's abundant hydraulic resources, in particular the Churchill Falls plant in Labrador.

Because the vast majority of the power produced at Churchill Falls is committed under long term contract for sale to Hydro Quebec, this energy is effectively unavailable to meet the province's needs. When the equivalent of 98.8 petajoules of Churchill Falls energy is removed from supply availability, the province is then shown as needing to import 68 percent of its 1994 energy requirement. Dominated by the transportation sector, this results from the heavy influence of imported petroleum products. With the transportation sector removed, the province's import requirement is reduced to 53 percent.

Indigenous supply sources such as peat and wind have also been identified as potential future supply substitutes for foreign sourced petroleum products. Such substitution, however, depends on many varied factors including the relative prices for the various alternatives. With the larger and generally least expensive hydraulic sites already developed, and with the alternatives typically recording a price penalty in comparison to hydraulic, the development of the province's remaining indigenous energy supply options is very much influenced by petroleum prices. In recent years, relatively low international crude oil prices have contributed to the increased attractiveness of petroleum use.

Energy Efficiency

An issue related to energy supply is the efficiency with which energy resources are being used. Canada is one of the most energy-intensive industrialized countries in the world. However, between 1973 and 1992, Canada's energy use per unit of production dropped over 25 percent. For Newfoundland and Labrador, figures for 1973 are unavailable, however, for the period 1979 - 1992 energy intensity dropped from .73 to .69 tonnes of oil equivalent (TOE) per $1000 of GDP, a decline of 5.5 percent. The corresponding figure for Canada is a 21.2 percent decline.

Stated differently, from 1979 - 1992 Canada experienced a 21.2 percent increase in energy efficiency. These improvements are the result of consumers responding to energy price increases as well as improvements in technology. They also reflect the impact of various programs undertaken by the federal and provincial governments to accelerate conservation and oil substitution.

The generally lower efficiency improvements recorded for Canada when compared to other countries such as the USA and Japan and to the total OECD countries, is explained in part by the uniqueness of Canada's economy and geography, and by the Canadian system of controlled petroleum prices in the 1970's. With prices held below world levels, it is believed that relatively less incentive existed in Canada to opt for efficiency improvements early.

The low percentage improvement in energy utilization per dollar of GDP in Newfoundland when compared to Canada and other OECD countries is attributed to a combination of (1) a higher growth rate in energy consumption - 8.3 percent (1992/1979) for Newfoundland versus 5.1 percent for Canada, and (2) a dramatically lower GDP growth rate of 13.6 percent for Newfoundland versus 33.7 percent for Canada. The high rate of energy utilization in Newfoundland (.69 versus .28 for the OECD total) is explained by an economic structure that is characterized by a relatively low value added component of GDP and a relatively high proportion of energy demand represented by the transportation and residential sectors, thereby contributing to a relatively high energy input per dollar of output.

Energy and the Environment

Environmental issues, particularly those relating to atmospheric pollution, have attracted public concern at all levels - international, national, provincial, and local. In this context, energy use, most notably the combustion of fossil fuels, is recognized as the major source of atmospheric pollution related to human activities. The interaction between energy and the environment is typically discussed under three broad classifications dealing will atmospheric emissions. These are: (1) Climate Change, (2) Acid Precipitation, and (3) Ground-Level Ozone (Smog).

As one of its commitments under the Framework Convention on Climate Change, Canada's Federal Government established the national goal of stabilizing greenhouse gas emissions at 1990 levels by the year 2000. Recent estimates forecast national emissions at 13 percent higher than 1990 in 2000. Nevertheless, the Government of Canada remains firmly committed to achieving the goal, and reiterated this at the first Conference of the Parties to the Convention in Berlin in April 1995. This commitment does not include CFC's, since the phase out of these materials is already in progress under the Montreal Protocol.

Executive Summary

Canada's energy-related CO_2 emissions are about 2 percent of the global totals. In terms of emissions intensity (tonnes of CO_2 per $ of Gross Domestic Product), Canada compares favourably with other industrialized nations. However, Canada is second highest to the United States in emissions on a per capita basis. This is attributed primarily to Canada's geography, climate, and economic structure.

Newfoundland's energy-related CO_2 emissions are about 2 percent of Canada's. Per capita emissions for Newfoundland are 5th highest among provinces. There are, however, distinct differences in the sector proportions between Canada and this Province. Industrial sector emissions have a far lower share in Newfoundland, while transportation sector emissions are relatively higher. These differences are often attributed to differences in economic structure and, of large significance, the proportion of hydroelectric generation in Newfoundland's electrical power system.

For Newfoundland, sulphur dioxide levels representing in the order of 4.6 percent of the Canadian total have increased since 1988. This is attributed primarily to the resumption of process emissions from the oil refinery at Come By Chance. These emissions are included in the industrial sector. While the refinery accounted for 65 percent of provincial SO_2 emissions in 1993, it is expected that reductions will be realized as the refinery owners implement new environmental controls.

The next largest single source of SO_2 emissions is the burning of fuel oil at the Holyrood generating station. Through agreement with the provincial government, SO_2 emissions from this source are capped at an annual target of 25 kt. The station has kept its emissions below this target since 1989. The high proportion of hydroelectric generation in the province results in the electricity sector's share of SO_2 emissions being lower than in Canada overall, where coal-fired generation is very significant.

Newfoundland's NO_x emissions result primarily from transportation, as is the case for Canada.

A federal-provincial plan for the control of nitrogen oxides and volatile organic compounds aims to resolve ground-level ozone problems in Canada by the year 2005. The goal is that concentrations should not exceed the maximum acceptable levels after this date. Canada has also signed major international protocols to reduce emissions of pollutants that produce ground-level ozone.

There are only three areas in Canada where ground-level ozone is considered a problem; the lower British Colombia mainland, the Windsor-Quebec City corridor, and the area around the Bay of Fundy. In Newfoundland, due to the relatively small population, the wide dispersion

of industrial activity, and the windy climate, locally generated smog is generally believed not to be a concern. However, there is a possibility that significant quantities of ozone and ozone precursors are transported to Newfoundland from eastern Canada and the USA. As shown in Table 4.2, Newfoundland accounts for only about 2.3 percent of Canadian VOC and NO_x emissions.

Energy Prices

World crude oil price levels are a determining factor in the price of petroleum products and significantly influence the price of many other energy sources. Although long term crude prices are presently expected to be in the order of $20 US 1995 per barrel, recent years have recorded a downward trend. This trend is illustrated in Figure 5.1 which shows world crude oil price movements since the early 1970's. The decrease in recent years is attributed to decreased world oil demand, and excess supplies from both OPEC and non-OPEC producers.

Illustration respecting the retail price of petroleum products in Newfoundland is accomplished by comparing the various price components as shown in Figure 5.3. These components include the cost of crude, refining and marketing, federal and provincial taxes, and retailer margin. This figure shows that for regular unleaded gasoline, taxes levied by the federal and provincial governments amount to 30.6 cents per litre, or 49 percent of the current 62.9 cents per litre price. The cost of crude accounts for another 15.6 cents per litre, leaving 12.2 cents per litre for refining, marketing and distribution, and 4.5 cents per litre for the retailer.

For automotive diesel fuel, taxes represent 24.9 cpl or 37% of the current 67.9 cent per litre price. The 7% goods and service tax is the only tax applied to furnace fuel.

In addition to the crude cost and tax components, product prices are influenced by the particular circumstances characterizing each market area. For example, a retailer operating in St. John's with high volume sales can afford to keep a low margin. This may not be the case in certain rural areas where sales volumes are lower. In this case, the retailer must therefore increase the margin in order to maintain a reasonable profit. Also, the level of competition and the cost of marketing, distributing, and storing product throughout the province add to the retail price.

To facilitate comparison of electricity rates in Newfoundland with those in other Canadian provinces and the Territories, survey results are presented for residential and commercial rates for select locations, and industrial rates charged by various utilities across Canada.

Executive Summary

At an average of 8.70 cents per kilowatt hour (¢/kWh), residential electricity customers in St. John's are shown to be paying slightly above the Canadian average of 8.41 ¢/kWh. Industrial customers in Newfoundland at 3.64¢/kWh are shown with a significant advantage over the Canadian average of 4.28¢/kWh.

Oil and Gas

The oil and gas resources in the offshore areas adjacent to the province of Newfoundland and Labrador are managed by the Canada-Newfoundland Offshore Petroleum Board (CNOPB) on behalf of the Government of Canada and the Government of Newfoundland and Labrador. The Board's authority is derived from the legislation implementing the 1985 Atlantic Accord which provides for joint management of the offshore hydrocarbon resources. The province's onshore oil and gas resources are managed directly by the Government of Newfoundland and Labrador through the Department of Natural Resources.

Oil and gas industry activities are contributing to significantly increased energy sector employment. It is estimated that the energy sector typically accounts for in the order of 3,000 person years of direct employment annually. In recent years this figure is substantially higher due to construction activity related to Hibernia. Direct Hibernia related employment alone accounted for 4,600 person years of Newfoundland based employment in 1994 and, peaking at 6,431 jobs in September 1995, will account for in the order of 5,700 person years in 1995. Over the long term production phase beginning in late 1997, annual direct Hibernia employment is estimated to be in the 800-1,000 person years range. Also, to the extent that other discoveries such as Terra Nova begin production operations, additional petroleum sector employment will be realized, possibly a further 500-1000 person years annually.

Select Hibernia project construction activities and milestones between 1994 and full field commissioning in 1998 are summarized below.

Platform Base: The first phase of the platform (GBS) was completed and floated out of the drydock to the deepwater construction site (DWS) in November 1994. The first 2 of 9 slipforming operations at the DWS were completed in February 1995. Operations 3, 4, 5, and 6 were completed in May 1995, operation 7 was completed in July while operation 8 was completed in October 1995; and the final operation is scheduled for March 1996. Fabrication of the components of the platform's four utility shafts has been completed and delivered to Bull Arm. Installation and testing work will take the GBS to completion in November 1996.

Platform Topsides: Construction, assembly, and hookup work characterize the various topsides work activities. These activities relate to 5 supermodules and 7 other modules, referred to as topsides mounted structures (TMS). The wellhead supermodule (M20) was completed and moved from its construction hall at Bull Arm to the adjacent assembly pier in May 1995. The remaining supermodules, mud (M30), process (M10), utility (M40), and quarters/services (M50) have all been delivered to Bull Arm. The east and west drilling derricks (TMS M71/72), have been delivered to Bull arm for assembly and hookup. Also ready for assembly and hookup are the remaining TMS. These are the piperack (M73) - fabricated at Marystown, and the lifeboat stations (M81/82), flareboom (M83), and helideck (M84) - all fabricated at Bull Arm. Final topsides completion is scheduled for November 1996.

Figure 6.4 shows the construction locations for the various modules and illustrates the placement of these modules on the completed platform.

Mating & Tow Out: Mating operations to connect the topsides to the GBS are scheduled for March 1997 with tow out to the field in June 1997.

Production Start: Final ballasting, drilling start, and first production are scheduled for September, August, and December 1997, respectively.

In addition to Hibernia, there are 20 other significant discoveries in the Newfoundland offshore. Of these, the most likely candidates for development are Terra Nova, Hebron, and Whiterose.

Since 1988 there has been a renewed interest in western Newfoundland by the petroleum industry. This renewal of interest is partly due to efforts by the Department of Natural Resources to market and encourage activity in the area, to a reinterpretation of the area's geology, and to industry's realization that this area had not been properly evaluated using modern technology.

In 1992-1993 Labrador Mining and Exploration Co. Ltd. acquired 93 km of seismic data in the Parsons Pond area. In 1993 - 1994 Hunt Oil Company and Marathon Petroleum Canada Ltd. acquired 3,300 km of aeromagnetic data in the Port Au Port/Bay St. George area, with Hunt Oil acquiring an additional 87 km of seismic data on the Port Au Port Peninsula.

Another important component in the development of the province's petroleum resources is the establishment of a stable fiscal regime. To this end, the Minister of Natural Resources (formerly Mines and Energy), on June 20, 1994, announced a royalty regime for application to the province's onshore petroleum resources. Also, a regime for the province's offshore petroleum resources is currently being developed. These regimes are designed to be sensitive to the level of risks, to be competitive with other jurisdictions, and to provide for a fair sharing of revenues.

The current round of onshore exploration is unique in the area's history in that modern exploratory techniques which can effectively map the subsurface are being applied. These efforts have already provided new geological insight and have lead to the identification of drillable prospects, the first of which is now being drilled by Hunt and its partner, Pan Canadian. This well, spudded in September 1994 and named Port Au Port #1, is located on the southwest corner of the Port Au Port peninsula.

In June of this year, Talisman Energy Inc. of Calgary announced its intention to spud a well before the end of the year into EL1008, south of the Port Au Port Peninsula. This well is to be directionally drilled from the onshore to the offshore.

Further, Hunt Oil and Pan Canadian recently (July 1995) announced that, following rig release from the Port Au Port #1 well, they will commence drilling a 3,000 meter well at Long Point on the Port Au Port Peninsula. As with the Talisman well, this well will be directionally drilled from the onshore to the offshore.

On November 19, 1995, International Exploration Consultants (Canada) Inc., (IEXCO) of Calgary commenced a speculative seismic program in the Port Au Port/Stephenville area.

Also, on November 23, 1995, the Minister of Natural Resources announced a Request for Bids for thirty one parcels throughout western Newfoundland. Bids, in the form of work commitments, are to be received by March 22, 1996. It is anticipated that the issuance of new exploration permits will result in an increased level of exploration activity in western Newfoundland.

Energy Review

1. INTRODUCTION

Energy and energy related activities represent a large component of the provincial economy. These activities affect the productivity and competitiveness of Newfoundland's industries, especially the heavy industrial users of electricity. Also, the price of energy and its availability affect the standard of living of the province's citizens.

Each year Newfoundlanders and Labradorians spend in excess of $1.5 billion on energy. This is equivalent to about 1/6 of provincial Gross Domestic Product (GDP). Two-thirds of this is for imported petroleum products, either directly for gasoline, heating oil, etc., or indirectly for heavy fuel oil used to generate electricity. In addition, the province exports in the order of 95 to 110 petajoules (26,000 to 30,000 gigawatt hours) of electrical energy to Quebec annually.

In terms of employment, it is estimated that the energy sector directly accounts for in the order of 3,000 person years annually. In recent years this figure is substantially higher due to construction activity related to Hibernia. Direct Hibernia related employment alone accounted for 4,600 person years of Newfoundland based employment in 1994 and, peaking at 6,431 jobs in September of 1995, will account for in the order of 5,700 person years for 1995. Over the long term production phase beginning in late 1997, annual direct Hibernia employment is estimated to be in the 800-1,000 person years range. Also, to the extent that other discoveries such as Terra Nova begin production operations, additional petroleum sector employment will be realized, possibly a further 500-1000 person years annually.

Given the importance of energy and energy related activities, the purpose of this report is to provide a detailed review of the province's energy sector. It is intended that the information presented be of use to a wide cross-section at the international, national, and provincial levels, including the energy supply industry, government departments and agencies such as Natural Resources Canada and the National Energy Board, those involved in environmental planning and assessment, and other interested groups and individuals.

In addition to this introduction, the report is divided into 6 chapters and 3 appendices. Chapter 2 provides an overview of Newfoundland energy demand. Both primary and secondary demand are discussed in terms of their major components, illustrating the relative importance of each in the context of the entire demand equation.

Chapter 3 deals with energy supply. It provides an overview of both the indigenous and foreign supply sources. It also discusses alternative energy sources and energy efficiency.

Chapter 4 discusses the interaction between energy use and development in the context of related environmental impacts.

Energy prices are examined in Chapter 5. World crude oil prices as well as Canadian and Newfoundland electricity and petroleum product prices are discussed. The prices of alternative energy sources are also referenced in this chapter.

Oil and gas developments form the subject for the sixth chapter. These developments are presented in terms of their historical context and the potential for future activity. Distinction is drawn between offshore and onshore activity.

The three appendices provide a glossary of energy sector terms, a summary of select energy equivalents and conversion factors, and a list of energy sector contacts within the Department of Natural Resources.

Due to a lag in data collection and reporting by Statistics Canada, complete demand information for 1995 will not become available until August of 1996. It is for this reason that updates of this report will be made available in the fall of each year.

This review is intended to complement two additional reports that are currently in the draft stages of preparation. These reports will deal with (1) Newfoundland Energy Trends and Comparisons, in the context of national and international developments, and (2) Newfoundland Energy Demand and Supply Projections.

2. ENERGY DEMAND

2.1 Energy Flows and Primary Demand

This chapter discusses the sources and disposition of Newfoundland's energy flows. These are illustrated in Figure 2.1, showing the relationship between energy production, exports, imports, primary energy demand, and secondary energy demand.

Beginning with total primary demand as the sum of domestic production and imports, the subtraction of exports leaves domestic supply availability (sometimes referred to as domestic primary demand). The figure shows Newfoundland as producing 61.0 percent of its primary energy requirement with the remaining 39.0 percent sourced through imports of petroleum products, including small amounts of coke and coal. These balances are discussed further in Chapter 3 dealing with supply.

Figure 2.1 also shows the overall 1994 demand for energy from Newfoundland and Labrador as totalling 232.0 petajoules, of which , 98.8 petajoules (42.6%) is exported to Quebec as inter-regional transfers.

It is noted that petroleum required as an input to the refinery process at Come By Chance is imported, and virtually all petroleum products produced at the refinery are destined for export markets. Also, because of data limitations resulting from confidentiality concerns, complete data for the Come By Chance operation could not be published. For these reasons, this review does not detail the refinery's import needs or exports. The small amount of Come By Chance petroleum products marketed locally is included in the secondary demand figures, and supply industry use does include fuels consumed and losses incurred in production operations.

To arrive at the amount of energy available for final consumption (secondary energy demand) it is necessary to adjust domestic primary energy demand (available supply) to account for the energy used by the energy supply industry. Energy supply industry use represents fuels used and losses incurred in production, processing, transportation and distribution as well as conversion losses in electricity generation where coal, gas, and oil are transformed as intermediate fuels into electricity. These adjustments are further illustrated in Figure 2.2 where primary energy demand is shown in relation to secondary demand and its various sectoral divisions, including a small component for non-energy use.

Thus, accounting for energy supply industry use, 133.2 petajoules is required to supply the province's 116.8 petajoules of secondary end use demand. When adjustments are made for both exports and supply industry use, the province needs to import in the order of 64 percent of its energy requirement.

The Newfoundland primary and secondary demand figures for 1993 and 1994 are further compared in Table 2.1. This table shows the year to year percentage change and provides demand estimates in terms of both petajoules (PJ) and barrels of oil equivalent (BOE). The BOE estimates are shown in order to provide a point of reference to a more familiar energy measure. In this context, one could interpret the 77 million barrels equivalent figure for 1994 as between one and one half and two times the total annual peak production expected from Hibernia. The BOE estimates assume an average of 168,000 barrels per PJ; and, for electricity conversion, heavy fuel oil with 151,000 barrels per PJ and an assumed plant efficiency of 33 percent are assumed.

The overall 9.8 percent primary energy demand decrease from 1993 to 1994 is primarily explained by decreased supply industry use and reduced transfers of electricity to Quebec. The reduction in supply industry use resulted from a decrease in demand at the Holyrood thermal generating plant, and decreased manufacturing at the Come By Chance oil refinery, which was inoperative between April 24th to the end of October. The refinery resumed full production in November, employing in the order of 400 people.

The 8.3 percent reduction in electricity transfers to Quebec by CF(L)Co was caused by below average precipitation levels and inflows into Labrador reservoirs.

2.2 Secondary Energy Demand

The amount of energy delivered to the final consumer includes energy consumed within the residential, commercial/institutional, industrial, and transportation sectors; plus the demand for non-energy products (asphalt, lubricants, greases and naphtha specialties).

A comparison of 1993 and 1994 secondary energy demand is presented in Table 2.2. This table shows total secondary energy demand as virtually unchanged, increasing only by 0.3 percent, from 116.5 petajoules in 1993 to 116.8 petajoules in 1994. Decreases in residential, commercial/institutional, and transportation sector demand, plus a 5.0 percent decrease in non-energy products demand, were offset by the increased energy demand in the industrial sector. In summary, while electricity demand increased by 2.4 percent, the demand for wood and petroleum products decreased by 2.3 and 2.5 percent, respectively. Coke and coal demand increased by 73.7 percent, due to its increased usage in the mining sector.

Figure 2.3 illustrates petroleum products as the greatest energy source by fuel type, representing approximately 60 percent of total demand. This is explained by their heavy use in the transportation sector. From a sectoral demand point of view, transportation, lead by motor gasoline, is the primary energy user. Following transportation, the industrial and residential sectors are the major energy users of petroleum products.

Decreases for petroleum product demand is further illustrated by Table 2.3. This table shows the substantial decreases in kerosene and stove oil, light fuel oil and aviation turbo fuel

demand as leading the overall petroleum products demand decrease. Gas plant natural gas liquids (NGL's), account for a very small portion of the province's total energy demand. While they show a decrease of 34.3 percent, in absolute terms, the decrease is only 0.342 petajoules. It is noted that the term gas plant NGL's used in this report maintains consistency with the fuel type categorizations employed by Statistics Canada. This category is defined to include propane, butane, and ethane. For Newfoundland, virtually all of the product is propane.

Details respecting the various year over year demand changes are provided in the specific sectoral chapter discussions below.

2.2.1 Residential

The residential sector represents energy demand by all occupied dwellings in the province. Energy demand in this sector decreased from 27.182 petajoules in 1993 to 26.773 petajoules in 1994. Significant decreases in the demand for kerosene, stove oil and gas plant N.G.L.'s and light fuel oil accounted for the net 1.5 percent decrease in residential sector energy demand (see Table 2.4).

The distribution of residential sector energy demand by fuel for 1994 is illustrated in Figure 2.4. This figure shows that 44.5 percent of residential sector energy demand is supplied by electricity; 33.1 percent by petroleum products, and 22.4 percent by wood.

2.2.2 Commercial/Institutional

The commercial sector includes retail outlets, shopping malls, and federal, provincial and municipal buildings. Total energy demand in this sector decreased by 1.1 percent in 1994 (see Table 2.5).

While electricity demand showed a marginal increase, decreases in the demand for petroleum products, with the exception of heavy fuel oil, resulted in the net decrease in commercial/institutional energy demand for 1994. A number of factors account for these decreases. These include an increase in office vacancies, the implementation of energy efficiency and energy cost savings programs and the convenience of electricity as opposed to alternative fuels in the heating of major commercial outlets. The demand for wood in the commercial sector remained stable over the past year.

The distribution of commercial sector energy demand by fuel for 1994 is illustrated in Figure 2.5. This figure shows that 62.1 percent of commercial sector energy demand is supplied by electricity; 37.3 percent by petroleum products, and 0.6 percent by wood.

2.2.3 Industrial

The industrial sector includes the subsectors of forestry and construction, mining, and manufacturing. Major energy consumers in this sector are the two Iron Ore Company of Canada locations in Labrador, (mining); the three pulp and paper mills located at Grand Falls, Stephenville, and Corner Brook, (manufacturing); and, the Come By Chance refinery.

Table 2.6 shows that total energy demand in this sector increased by 5.7 percent from 33.024 petajoules in 1993 to 34.900 in 1994. Increases in the demand for petroleum products and electricity, as well as coke and coal, contributed to the increased energy demand in this Sector.

Table 2.7 presents the information for 1994 by fuel and industrial subsector. This information is then presented graphically by subsector and fuel in Figure 2.6. The figure illustrates that the Mining and Manufacturing subsectors account for 55.3 percent and 41.7 percent of industrial sector demand. The Forestry and Construction subsector accounts for the remaining 3.0 percent. Considered by fuel, the distribution is 48.8 percent for electricity, 41.0 percent for petroleum, 9.5 percent for coke and coal, and 0.7 percent for wood.

2.2.3.1 *Mining*

Table 2.8 illustrates total energy demand in the mining subsector. This table shows mining sector energy demand increasing from 17.311 petajoules in 1993 to 19.286 petajoules in 1994. This 11.4 percent increase is the result of a 10.5 percent increase in electricity demand coupled with a 73.7 percent increase in the demand for coke and coal. Total demand for diesel fuel oil and heavy fuel oil declined over this period. There was no gas plant N.G.L. consumption recorded for the mining sector in 1994.

2.2.3.2 *Manufacturing*

The manufacturing sector experienced a decrease of 0.6 percent in energy demand during 1994. Over 80 percent of energy consumed in the manufacturing sector can be attributed to the pulp and paper industry. As shown in Table 2.9, the demand for petroleum products increased by 5.3 percent while electricity demand decreased by 2.0 percent. The demand for wood (woodchips and sawmill residue) decreased by 0.15 petajoules or 38.1 percent. This decrease is attributed to decreased use of sawmill residue by the Abitibi Price Pulp and Paper Mills in Grand Falls and Stephenville.

2.2.3.3 *Forestry and Construction*

Table 2.10 provides energy demand information for the forestry and construction subsector. Petroleum product demand is shown as decreasing by an overall 1.6 percent, from 1.087 petajoules in 1993 to 1.070 petajoules in 1994.

2.2.4 Transportation

Demand for energy in the transportation sector is the total of that consumed by the road, air, and marine subsectors.

Table 2.11 shows this sector as experiencing an overall decrease of 2.2 percent in 1994. With the exception of light fuel oil, all products experienced decreases. Light fuel oil, while showing an increase of 169.2 percent, in absolute terms, the increase was only 0.022 petajoules. Figure 2.7 illustrates that gasoline, at 48.4 percent, is the largest consuming fuel in the transportation sector, followed by diesel fuel oil at 32.4 percent and aviation turbo at 18.7 percent. The remaining fuels comprise only 0.5 percent of transportation energy demand.

The distribution of transportation sector energy demand by subsector is illustrated in Table 2.12 and Figure 2.8. The figure shows the road, air, and marine subsectors accounting for 62.3 percent, 18.9 percent and 18.8 percent, respectively.

2.2.4.1 *Road*

As shown in Table 2.12, total petroleum demand in the road transport subsector decreased by 1.3 percent over the 1993-1994 period. All three fuels in this category; gasoline, automotive diesel, and gas plant N.G.L.'s, witnessed demand decreases.

2.2.4.2 *Air*

Total energy demand for the air transport subsector decreased by 5.4 percent in 1994. Both aviation turbo fuel and aviation gasoline recorded decreases over the period.

2.2.4.3 *Marine*

Total energy demand for the marine subsector decreased by 2.1 percent from 8.189 petajoules in 1994. Diesel fuel oil, which accounts for 99 percent of the fuel consumed in this subsector, showed a decrease of 1.4 percent in 1994.

3. ENERGY SUPPLY

3.1 Introduction

Newfoundland and Labrador enjoys an overall energy surplus position. As was shown in Figure 2.1, in 1994 Newfoundland and Labrador produced 141.5 petajoules and consumed 133.2 petajoules. This position is helped by the province's abundant hydraulic resources, in particular the Churchill Falls plant in Labrador.

Because the vast majority of the power produced at Churchill Falls is committed under long term contract for sale to Hydro Quebec, this energy is effectively unavailable to meet the province's needs. When the equivalent of 98.8 petajoules of Churchill Falls energy is removed from supply availability, the province is then shown as needing to import 68[1] percent of its 1994 energy requirement. Dominated by the transportation sector, this results from the heavy influence of imported petroleum products.

While practical alternatives to petroleum use are not yet available to meet transportation sector energy demand, such alternatives - primarily hydraulic in Newfoundland - are meeting the demand in other sectors.

Some further insight into Newfoundland's overall energy supply makeup can be obtained by considering the energy supply sources for the residential, commercial/institutional, and industrial sectors only - setting aside the transportation sector. Here, after adjustment for secondary electricity produced from foreign sourced petroleum, the province's indigenous hydraulic and wood resources supply in the order of 53[2] percent of its energy needs.

As the above reference to residential, commercial/institutional, and industrial sector demand shows, in the order of 35.0 petajoules (47 percent) of the demand by these sectors is currently supplied by foreign sources. With a significant level of undeveloped hydraulic potential remaining (the most noteworthy being the Lower Churchill River sites of Gull Island Rapids and Muskrat Falls - in the order of 3,000 MW's - and various on Island sites of approximately 300 MW's), the possibility exists to substitute hydraulic based electricity production for petroleum based production in these sectors.

In addition, other indigenous supply sources such as peat and wind have also been identified as potential future supply substitutes for foreign sourced petroleum products. Such substitution, however, depends on many varied factors including the relative prices for the various alternatives. With the larger and generally least expensive on Island hydraulic sites already

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[1] Figure 2.1: 90.5÷133.2 = .68 x 100 = 68%

[2] Figure 2.1 and Table 2.2: (36.1 - 3.1 + 6.3) ÷ (116.8 - 42.5) = .53 x 100 = 53%

developed, and with the alternatives typically recording a price penalty in comparison to hydraulic, the development of the province's remaining indigenous energy supply options is very much influenced by petroleum prices. In recent years, relatively low international crude oil prices have contributed to the increased attractiveness of petroleum use.

For the future, and depending on factors such as export market opportunities for Labrador power and Island demand growth, a transmission infeed to the Island portion of the province is a possible source of new power for the Island.

3.2 Electricity

The electrical power industry encompasses both the generation of electricity and its distribution to the end user. In Newfoundland the industry is dominated by two utilities - Newfoundland and Labrador Hydro (NLH) and Newfoundland Power (NP). NLH is a crown corporation and its primary activity is the generation, transmission, and wholesale distribution of electric power throughout the province. NP is an investor owned utility. Its activities are concentrated primarily on retail distribution and do not extend to Labrador. Together NLH and NP serve about 240,000 customers. In addition to some 35,000 customers living in rural communities in Newfoundland and Labrador, NLH's customers include NP and the large industrial users, including the mining companies, pulp and paper mills, and the Come By Chance refinery.

While purchasing the majority of its power from NLH, NP does generate some of its own requirements. Also, Deer Lake Power and Abitibi Price generate electricity, primarily for their own consumption.

Table 3.1 reveals that the province of Newfoundland and Labrador has a total electrical energy supply capacity of 7,646 MW's. Of this amount, NLH controls 95 percent or 7,253 MW's. This includes the 5,428 MW facility at Churchill Falls, the 225 MW facility at Twin Falls, and a number of thermal powered plants located at various locations in Labrador and on the Island. It is noted that the Twin Falls plant is presently moth-balled. As compensation to the mining companies for the associated lost output, the equivalent volume of power is now being delivered by Churchill Falls.

With the exception of the Churchill Falls and Twin Falls facilities, the province's largest generating stations are located on the Island. Controlled by Newfoundland and Labrador Hydro these include: Bay D'Espoir (604) MW's); Holyrood (505 MW's); Cat Arm (127 MW's); Upper Salmon River (84 MW's); Hinds Lake (75 MW's); Paradise River (8 MW's); and Snooks Arm/Venan's Bight (1 MW). While the Holyrood site is primarily oil fired - 490 MW's oil and 15 MW's Gas Turbine - the others are hydroelectric sites. Figure 3.1 shows the location of these

sites in the context of NLH's distribution system. The remaining generation, 178 MW's and 215 MW's, is provided by NP and industry, respectively.

NP's 87 MW's of hydraulic production comes from 22 different locations throughout the Island. The 205 MW's of industry hydroelectric capacity is distributed - 129 MW's by Deer Lake Power, 58 MW's by Abitibi Price, and 18 MW's by the Iron Ore Company of Canada (IOCC) at Menihek. Most of the power produced at the Menihek facility is exported to Shefferville, Quebec.

Similarly, as referenced above, the province's thermal generating capacity is represented by numerous sites, both on the Island and in Labrador. NLH operates some 35 of these sites representing 196 MW's in addition to Holyrood's production. The 91 MW's of thermal production controlled by NP originates from 8 locations, all on the Island. This includes a 30 MW steam plant in St. John's that was closed on January 1, 1995, but is available as a stand-by unit for emergency use. The 10 MW's of industry thermal production is distributed as 7 MW's by the Department of National Defence at Goose Bay and 3 MW's by IOCC at Labrador City.

3.3 Petroleum

As previously discussed, there were 87.2[3] petajoules of petroleum products consumed in Newfoundland and Labrador in 1994. Aside from a very small percentage supplied by the Come By Chance refinery, the province is completely dependent on imported petroleum products to meet these requirements. However, the future development of offshore and onshore oil and gas resources does offer some potential. For example, the Hibernia platform will require a significant amount of power to operate platform facilities and to maintain reservoir pressure. It is expected that this power will be provided from natural gas produced at the field.

Petroleum product supply in the province is largely characterized by three oil companies serving an estimated 95 percent of the market. These companies; Ultramar, Irving, and Imperial operate refineries in Eastern Canada capable of producing about 610,000 barrels of refined product per day. While the Ultramar refinery in Quebec has some access to Western Canadian crude, the bulk of the refinery feedstock is provided by the foreign crude oil market. In 1994, over 220 million barrels of crude oil, or about 606,000 barrels per day, were imported into Eastern Canada. Most of this crude, about 76 percent, originated from the United Kingdom (28 percent), Norway (24 percent), Saudi Arabia (13 percent) and Nigeria (11 percent).

The Come By Chance refinery - North Atlantic Refining Limited - is a major contributor in the province's petroleum sector. The refinery has a rated capacity of 105,000 barrels of oil per day and crude and product storage for over 7.2 million barrels. In addition, the deep water

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[3] 90.5 PJ less coke and coal demand of 3.3 PJ = 87.2 PJ

facility is capable of receiving ultra large crude carriers in excess of 300,000 dwt directly at the dock.

While the majority of the refinery's production is destined for the American market, a small portion is distributed locally. The refinery produces significant volumes of propane and butane. In the past this production had to be flared as a result of inadequate export facilities and insufficient local demand. More recently, a cooperative project to stimulate the market for propane as a vehicle fuel was developed by the Newfoundland Departments of Natural Resources and Finance, Natural Resources Canada, the refinery owners, and Superior Propane Limited. The provincial contribution was to lower the tax rate on autopropane by about 50 percent.

So far, approximately 200 vehicle conversions have been carried out. In addition, the use of propane from Come By Chance is displacing other petroleum products with less local content.

3.4 Alternative Energy

Alternative energy refers to non-conventional energy sources such as wood, wood waste, municipal solid waste, small-scale hydro, peat, tidal, geothermal, photovoltaics, and solar. As shown previously, wood supplies in the order of 5 percent of Newfoundland's energy needs. The small-scale hydraulic component of electricity production accounts for in the order of another 1 percent.

In Newfoundland, there are a number of alternative energy options at various sites throughout the province that show economic potential. These include several small hydro sites to generate electricity for the island grid, the use of sawmill waste as boiler fuel, wind-diesel power systems for isolated communities, and autopropane using surplus gas liquids from the Come By Chance refinery.

Projects such as these offer the potential to further support the use of local resources to displace imported petroleum products. Like conventional energy forms, the demand for alternative energy is influenced by its price relative to those of competing energy sources.

3.4.1 Small-Scale Hydro

Small-scale hydro remains the most readily available source of additional electric power for the island grid system. In 1992 Newfoundland Hydro called proposals for the supply of up to 50 MW's of electricity to be supplied by the private sector. Eleven submissions were received, offering a total capacity of 114 MW. After an internal review which included consideration of interconnection requirements and project supply prices, NLH announced in 1994 that four projects; Star Lake, South West River, North West River and Rattle Brook, totalling 38 MW,

were selected. The first delivery date for power from these sources is 1998, subject to environmental approvals.

In addition to these four sites, there are a significant number of other sites which could be developed in the future. These, along with three sites owned by Newfoundland and Labrador Hydro, and two sites currently owned by industry are shown in Figure 3.2. Also, Newfoundland Power is currently proceeding with a new plant on Rose Blanche Brook.

3.4.2 Biomass (Wood and Peat)

Wood continues to be a significant source of energy in the province. In addition to the widespread residential use of roundwood and sawmill waste, two of the three paper mills (Abitibi Price in Grand Falls and Stephenville), two major hospitals (James Paton Memorial and Grand Falls Hospital) and one other industrial facility (Newfoundland Hardwoods) have large wood-fired boilers installed.

At first appearance, the 6.3 petajoules of wood consumption may not seem significant to overall energy demand; however, its significance is elevated when exports of electricity to Quebec are removed to focus on the province's energy consumption. Of the 6.3 petajoules estimated to be consumed in 1994, 6.0 petajoules are attributed to the residential sector, representing 22.4 % of this sector's demand. The importance of wood fuel is further illustrated if only energy for space heating is considered. With space heating demand accounting for an estimated 60% of residential sector energy demand, and with virtually all of the wood use being attributed to heating, wood is shown to represent an estimated 37% of residential heating demand.

Due to a variety of factors, including data availability and reliability, some uncertainty exists with respect to the precise amount of wood consumed in the province. Because of this uncertainty and the apparent importance of wood fuel, especially to the residential sector, further study of wood fuel demand is planned over the coming year.

The interconnection of the St. Anthony area to the main Island electrical grid will have a significant impact on wood fuel consumption currently used in the generation of electricity. In this context, Newfoundland and Labrador Hydro is in the process of converting the 5 MW wood-fired power plant in Roddickton to an oil-fired standby unit. The plant currently burns approximately 50,000 tonnes of wood annually, of which sawmill waste constitutes about half.

An additional indigenous biomass fuel source available in Newfoundland and Labrador is peat. During 1992-93, a proposal to harvest and burn fuel peat to cogenerate steam for the Abitibi-Price mill in Stephenville and to supply 40 to 80 MW's of electricity to the Island grid was reviewed by the Department of Natural Resources. The Department concluded that the proposed peat fuel project could not compete with less expensive hydraulic projects at this time.

3.4.3 Wind

Newfoundland has one of the strongest wind regimes in North America. However, due to the relatively low production cost of conventionally generated electricity, and technical difficulties relating to the structural requirements for winter icing conditions, modern development of wind power has not yet occurred in this province. Research and development work being carried out at the Atlantic Wind Test Site in P.E.I. may point the way for this source of renewable energy in the future. Presently, it seems that wind energy may have potential to provide power in those remote communities that have high variable costs, good wind regimes, and that are not connected to the electrical grid.

3.5 Energy Efficiency

Much of the province's energy-using infrastructure and many operating practices can be more efficient. Gains in this area have the potential to yield significant cost savings and to contribute to reduced atmospheric emissions. With fossil fuel combustion being the primary contributor to the increase in atmospheric emissions and with indigenous substitutes for petroleum use in the transportation sector currently unavailable, efficiency improvements in this sector could be particularly important.

Canada is one of the most energy-intensive industrialized countries in the world. Table 3.2 provides energy efficiency measures for Canada and Newfoundland in comparison with select countries for 1973, 1979 and 1992. Between 1973 and 1992, Canada's energy use per unit of production dropped over 25 percent. For Newfoundland and Labrador, figures for 1973 are unavailable, however, for the period 1979 - 1992 energy intensity dropped from .73 to .69 tonnes of oil equivalent (TOE) per $1000 of GDP, a decline of 5.5 percent. The corresponding figure for Canada is a 21.2 percent decline. Or, stated differently, from 1979 - 1992 Canada experienced a 21.2 percent increase in energy efficiency. These improvements are the result of consumers responding to energy price increases as well as improvements in technology. They also reflect the impact of various programs undertaken by the federal and provincial governments to accelerate conservation and oil substitution.

The generally lower efficiency improvements recorded for Canada when compared to other countries such as the USA and Japan and to the total OECD countries, is explained in part by the uniqueness of Canada's economy and geography, and by the Canadian system of controlled petroleum prices in the 1970's. With prices held below world levels, it is believed that relatively less incentive existed in Canada to opt for efficiency improvements early.

The low percentage improvement in energy utilization per dollar of GDP in Newfoundland when compared to Canada and other OECD countries is attributed to a combination of (1) a higher growth rate in energy consumption - 8.3 percent (1992/1979) for Newfoundland versus 5.1

percent for Canada, and (2) a dramatically lower GDP growth rate of 13.6 percent for Newfoundland versus 33.7 percent for Canada. The high rate of energy utilization in Newfoundland (.69 versus .28 for the OECD total) is explained by an economic structure that is characterized by a relatively low value added component of GDP and a relatively high proportion of energy demand represented by the transportation and residential sectors, thereby contributing to a relatively high energy input per dollar of output.

In their May 1991 study for the Efficiency and Alternative Energy Branch of Energy, Mines and Resources Canada, Peat Marwick Stevenson & Kellogg Management Consultants (KPMG) concluded that "...there appears to be a considerable further untapped, cost-effective potential for energy efficiency gains in Canada". To identify the possibilities, KPMG cited Exhibit B below to illustrate Canadian potential for energy efficiency savings in the year 2020 compared to 1988.

Exhibit B
Summary of Case Studies
2020 Economically Attractive Potential for Energy Efficiency

	Potential	
Locus	PJ/Year	As % of Frozen Efficiency Energy Use
New and Retrofit Single Family Space Heating	321	44%
Residential Appliances	51	11%
New and Retrofit Office and Retail	212	36%
Light Vehicles	645	44%
Chemical Industries	210	37%
Forest Industries	NA	NA
Iron & Steel Industries	NA	NA
Drivepower	25,000 GWh	20% (15% - 21%)

NA = No estimate made in this case study.

Notwithstanding the identified potential, KPMG went on to identify a number of barriers to the achievement of this potential. They list these as:

- In international industries such as passenger vehicles and appliances, products are designed and manufactured to meet the needs of a market which is much broader than the Canadian market. This limits the ability of Canadian consumers and governments to achieve economically attractive levels of potential in Canada alone.

- The magnitude of economically achievable potential in many cases dwarfs the capability of existing infrastructure. For example, there are limited numbers of trained construction

trades to implement energy saving measures in residential housing. These constraints limit the rate at which potential could in fact be captured, particularly in the near term.

- In the residential and, more particularly, the commercial sectors, the structure of the development, ownership, and operation of buildings provides a pervasive environment of split incentives. These are barriers not only to the achievement of the "social optimum" efficiency, but even to the achievement of the optimal level of energy efficiency, when viewed from the private financial perspective of the ultimate owners or tenants.

- There is still to some extent an uneven playing field for energy efficiency measures, in which there is no agreement as to the true social or even avoided costs of conventional fuels. There is some distance to go before public utilities provide a set of such signals consistent with the social cost of energy supply in Canada.

- There have been gaps between the private and social costs of energy. This gap does not exist in the current study, because we have used projections of actual market prices as proxies for social opportunity costs.

- Typically, decision makers in both the private and public sectors use more stringent decision making criteria than those implicit in the net present value decision making criterion, with a social discount rate in real terms of 7 percent, which was used to calculate economic attractiveness.

Because of these barriers, because a study such as that completed by KMPG has not been completed for Newfoundland, and because reasonably accurate estimates of the potential in this energy area require highly disaggregated study and detailed end-use modelling, also not yet completed for this province, this section stops short of providing a quantitative estimate of the future energy savings potential for Newfoundland and Labrador.

As noted above, the Department of Natural Resources recognizes that energy efficiency improvements are important, especially as it impacts on our ability to control atmospheric emissions and to minimize the cost to the economy from the purchase of foreign sourced petroleum products.

Efforts are currently ongoing at increasing energy efficiency in the residential, commercial/institutional, industrial, and transportation sectors. Examples of programs and energy efficient measures are illustrated below.

With respect to the residential sector, the 1995 National Building Code for houses includes an energy efficiency code section (to be released in 1996). This code provides regional standards for maximum cost-effectiveness in energy-related housing components within each province, based on climatic conditions, building costs, and energy costs. The provincial government and

individual municipalities are considering adoption of the Code. Coupled with this, the R2000 program delivered by the Homebuilders Association and new national efficiency standards for many household appliances all aid in the reduction of energy consumption in the residential sector.

Energy use in the commercial/institutional sector will also be affected by changes to the National Building Code for non-residential buildings. This code will include standards for lighting and other energy-using features of commercial buildings.

Most sizeable industrial energy users have the capability to maintain their own energy efficiency knowledge. These companies have already implemented and promoted energy savings programs as an efficient and effective means of controlling energy costs.

Energy efficiency in the domestic portion of the transportation sector depends largely on purchase decisions (not only for vehicles but also for place of residence) and operating habits. These have proved quite resistant to direct influence in many jurisdictions. In this context, it is expected that federal fuel efficiency standards will continue to be a significant change agent in this subsector.

The commercial and industrial transportation subsectors appear to be extremely cost conscious with respect to energy use. Here, the Pro-Trucker program is actively assisting the trucking industry by providing energy related seminars and technical advice for truck owners and operators.

The electrical utilities, too, are committed to energy efficiency improvements. NLH is undertaking pilot projects in conservation and load management in remote communities, and NP has a strong commitment to energy efficiency programs and services.

NP has several mature energy efficiency programs in the residential sector and is developing programs to meet the needs of the commercial sector. Current residential energy efficiency programs include financing/rebates for insulation upgrades, heat recovery ventilation systems, energy efficient water heaters and quality thermostats. Energy efficient services include electric heating system design, 1-800 energy and home construction advice line and customer literature. NP is developing commercial programs in load management systems, heat recovery systems, and ground source heat pumps, and is studying the application of energy efficiency value-added electrotechnologies.

As reflected by the efficiency statistics quoted in Table 3.2, programs and services such as those discussed above are leading to improved energy efficiencies. While governments will continue to play a role in this area, it is expected that private sector programs will play an increasing role in influencing future energy efficiency gains.

4. ENERGY AND THE ENVIRONMENT

4.1 Background

Environmental issues, particularly those relating to atmospheric pollution, have attracted public concern at all levels - international, national, provincial, and local. In this context, energy use, most notably the combustion of fossil fuels, is recognized as the major source of atmospheric pollution related to human activities. The interaction between energy and the environment is typically discussed under three broad classifications dealing will atmospheric emissions. These are: (1) Climate Change, (2) Acid Precipitation, and (3) Ground-Level Ozone (Smog).

Figure 4.1 shows the relationship of emissions from energy-related and other activities in Canada for five gases: two greenhouse gases (carbon dioxide - CO_2 and methane - CH_4), the major gas involved in acid precipitation (sulphur dioxide - SO_2) and the two emissions related to smog (volatile organic compounds - VOC's - and the various "oxides of nitrogen" - NO_x).

This figure shows the energy sector as the primary contributor to atmospheric emissions from human activity. Before discussing these emissions in terms of their contribution to climate change, acid precipitation, and ground-level ozone, some of the sources of non-energy related emissions are identified.

In Canada, non-energy related emissions of CO_2 are the result of industrial processes such as those associated with cement, lime and ammonia production, as well as processes involving the use of coal and coke. Non-energy CH_4 emissions come from municipal landfills, domestic animals, manure and prescribed fires. NO_x emissions that are non-energy related include process emissions from the pulp and paper industry, copper and nickel production, iron and steel production, and cement and concrete production. General solvent use and dry cleaning operations are the largest sources of non-energy related VOC emissions in Canada, with other significant emissions from the wood industry, pesticide and fertilizer application, iron and steel production, the petrochemical industry and incineration. Most non-energy related emissions of SO_2 are from copper and nickel production. Lead and zinc production, pulp and paper mills, and iron and steel production also contribute process emissions of SO_2.

4.2 Climate Change

A small group of gases, principally carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFC's), and water vapour, help regulate the Earth's climate by trapping solar energy in the form of heat. This is the natural "greenhouse effect". Scientists have found that greenhouse gases act as an insulating blanket for the Earth's atmosphere. Without these gases, the Earth's average temperature would be about 33°C lower, making the climate too cold to support life.

Since the 1800's, concentrations of greenhouse gases in the atmosphere have risen substantially, due to increased human activity. This leads to the enhanced greenhouse effect. In particular, CO_2, N_2O, and CH_4 concentrations in the atmosphere have increased significantly as a result of the use of fossil fuels.[4] CFC emissions do not result from energy use.

Current evidence suggests that the Earth's climate is warming. Widely accepted estimates predict that the Earth's average temperature may increase by about 0.3°C per decade during the next 100 years. The average global temperature could be 1°C higher than it is now by the year 2025, and 3°C higher than current temperatures by the end of the next century.

A warming of this magnitude could significantly alter many important climatic features, such as rainfall patterns and regional drought. Canada's agriculture, forestry, and energy (hydro-electricity) sectors may all be significantly impacted. More severe storms and a rise in sea level, caused by thermal expansion of the oceans and melting of ice caps, could displace millions of coastal residents as a result of flooding. Entire ecosystems could be altered as the ranges and distributions of plant and animal species change. Economically, the costs to society could be enormous, although there may be benefits - for example, increased agricultural production and longer tourist seasons in some areas. Overall, however, the actual impacts of climate change cannot be predicted with certainty.

While greenhouse gas concentrations have definitely increased, (about 50 percent since pre-industrial times) scientists have been reluctant to state definitively that there has been a warming trend as a result. The predictions of a number of computer models indicate potentially severe consequences of continued increases in the levels of greenhouse gases, but these models are necessarily considerable simplifications of the real atmosphere. However, it is likely that the next formal assessment of this matter (due for release in 1996) will conclude there is sufficient evidence that human activity is changing the earth's temperature.

Notwithstanding the uncertainties, there is a generally serious consideration of this issue. Over 150 countries, including Canada, signed the Framework Convention on Climate Change (FCCC) at the United Nations Conference on Environment and Development in Rio de Janeiro in 1992. Following ratification by over the minimum of 50 countries, the Convention came into force in March 1994.

As one of its commitments under the FCCC, Canada's Federal Government established the national goal of stabilizing greenhouse gas emissions at 1990 levels by the year 2000. Recent estimates forecast national emissions at 13 percent higher than 1990 in 2000. Nevertheless, the Government of Canada remains firmly committed to achieving the goal, and reiterated this at the first Conference of the Parties to the Convention in Berlin in April 1995. This commitment does

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[4] Environment Canada, *Climate Change - Environmental Indicator Bulletin*, May 1994.

not include CFC's, since the phase out of these materials is already in progress under the Montreal Protocol.[5]

Global emissions of carbon dioxide are in the order of 100 times greater than methane emissions, and 10,000 times greater than CFC emissions, yet methane and CFC's have significant contributions to the global warming effect. This is explained by the fact that different greenhouse gases remain in the upper atmosphere for varying lengths of time, and have varying abilities to absorb infrared radiation. (This ability is quantified as global warming potential). To illustrate, the National Energy Board produced Table 4.1. This table shows that global carbon dioxide emissions account for 61% of the total enhanced greenhouse effect, methane contributes 15%, and CFC's contribute 11%. For comparison, the percentage contributions based on Canadian emissions are included in the last row of this table.

The levels and sector sources of Canada's and Newfoundland's greenhouse gas emissions are shown in Figure 4.2. These data are for 1990, which is the latest updated base year for this subject among FCCC signatory nations. In the 1990 estimates (Environment Canada, 1992), no attempt was made to estimate either methane or nitrous oxide on a provincial basis. It would be expected that this province's energy-related methane emissions would be relatively low, since most emissions result from natural gas production and use. Our nitrous oxide levels would likely be proportionate to our population at about 2 percent of Canadian emissions.

Canada's energy-related CO_2 emissions are about 2 percent of the global totals. In terms of emissions intensity (tonnes of CO_2 per $ of Gross Domestic Product), Canada compares favourably with other industrialized nations. However, Canada is second highest to the United States in emissions on a per capita basis. This is attributed primarily to Canada's geography, climate, and economic structure.

Newfoundland's energy-related CO_2 emissions are about 2 percent of Canada's. Per capita emissions for Newfoundland are 5th highest among provinces. There are, however, distinct differences in the sector proportions between Canada and this province. Industrial sector emissions have a far lower share in Newfoundland, and transportation emissions are relatively higher. These differences are often attributed to differences in economic structure and, of large significance, the proportion of hydroelectric generation in our electrical power system.

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[5] The Montreal Protocol is an international agreement which phases out trade in and production of CFC's. It was originated because these gases are the main cause of stratospheric ozone depletion.

4.3 Acid Precipitation

Acid precipitation is formed when sulphur dioxide (SO_2) and oxides of nitrogen (NO_x) in the atmosphere are transformed by contact with sunlight, ozone and oxygen into higher oxides, which then combine with moisture to form sulphuric acid and nitric acid, respectively. These two strong acids can do serious damage to the environment, with effects on fresh waters, fish, soil and plants.

A portion of the pollution from a given point source will affect the local environment and the rest will remain in the atmosphere for days and be transported thousands of kilometres by moving air masses. Large regions of this province are affected by acid precipitation due to long range transport of emissions from the industrial areas of the northern United States and central Canada. The critical load value for sulphate deposition is a 8 kg/ha/year (defined by a 1990 Long Range Transport of Air Pollutants (LRTAP) Assessment Document). Sulphate deposition greater than this critical value is detrimental to aquatic ecosystems. Five of six monitoring stations in the province measured sulphate deposition in 1993 in excess of the critical load. In Newfoundland, there are a few local regions affected by point sources of sulphur dioxide emissions. This local influence adds to the effects of pollutants from long range transport causing increased environmental impacts in the area around the point source.

Figure 4.3 shows energy related SO_2 emissions in Canada as primarily associated with electrical generation and industrial fuel use. NO_x emissions in Canada are attributed primarily to the transportation sector.

There are already SO_2 reduction agreements in place between the U.S. and Canada, and between the Canadian federal government and each of the provinces east of Saskatchewan. These agreements call for a cap on SO_2 emissions by 1995.

For Newfoundland, sulphur dioxide levels representing in the order of 4.6 percent of the Canadian total have increased since 1988. This is attributed primarily to a steady increase in process emissions from the oil refinery at Come By Chance. These emissions are included in the industrial sector. While the refinery accounted for 65[6] percent of provincial SO_2 emissions in 1993, it is expected that reductions will be realized as the refinery owners implement new environmental controls.

The next largest single source of SO_2 emissions is the burning of fuel oil at the Holyrood generating station. Through agreement with the provincial government, SO_2 emissions from this source are capped at an annual target of 25 kt. The station has kept its emissions below this target since 1989. The high proportion of hydroelectric generation in the province results in the

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[6] Annual Report on the Federal-Provincial Agreements for the Eastern Canada Acid Rain Program 1994, Environment Canada, October 1995.

electricity sector's share of SO_2 emissions being lower than in Canada overall, where coal-fired generation is very significant.

Newfoundland's NO_x emissions result primarily from transportation, as is the case for Canada.

4.4 Ground-Level Ozone

Ground-level ozone, the major component of smog, is not emitted directly to the atmosphere, but is formed by a complex series of reactions involving nitrogen oxides (NO_x), volatile organic compounds (VOC's), and sunlight. Ozone is formed locally in urban centres, and can be carried on prevailing winds from distant Canadian and United States sources. Weather strongly influences its formation and movement. Smog is known to have detrimental impacts on respiratory function and crop yields.

A federal-provincial plan for the control of nitrogen oxides and volatile organic compounds aims to resolve ground-level ozone problems in Canada by the year 2005. The goal is that concentrations should not exceed the maximum acceptable levels after this date. Canada has also signed major international protocols to reduce emissions of pollutants that produce ground-level ozone.

The distribution of Canadian energy related VOC's emissions is shown in Figure 4.3. The transportation sector and industry account for 53 percent and 32 percent of the total, respectively.

There are only three areas in Canada where ground-level ozone is considered a problem: the lower British Colombia mainland, the Windsor-Quebec City corridor, and the area around the Bay of Fundy. In Newfoundland, due to the relatively small population, the wide dispersion of industrial activity, and the windy climate, locally generated smog is generally believed not to be a concern. However, there is a possibility that significant quantities of ozone and ozone precursors are transported to Newfoundland from Eastern Canada and the USA. As shown in Table 4.2, Newfoundland accounts for only about 2.3 percent of Canadian VOC and NO_x emissions.

Issues involving lower-atmosphere ozone are separate from those involving the depletion of ozone in the upper atmosphere. The ozone in the upper atmosphere acts as an absorber of solar ultraviolet radiation. Since ultraviolet radiation is known to cause skin cancer, reduce crop yields, and have other detrimental impacts on the ecosystem, depletion of upper atmospheric ozone is a major global concern. With the exception of NO_x released directly into the stratosphere from jet aircraft, the ozone depleting gases (CFC's) are not a product of energy sector activity and, therefore, are not covered in this report.

4.5 Summary - Newfoundland and Labrador

Table 4.2 summarizes the energy related atmospheric emissions levels by pollutant for Canada, in comparison with those for Newfoundland and Labrador. Methane (CH_4) and Nitrous Oxide (N_2O) emissions are not reported for Newfoundland as this data has not been collected on a provincial basis. For the other emissions sources, Newfoundland's share ranges from 1.7 percent to 4.6 percent.

5. ENERGY PRICES

5.1 Petroleum

5.1.1 World Crude Oil Prices

World crude oil price levels are a determining factor in the price of petroleum products and significantly influence the price of many other energy sources. Although long term crude prices are presently expected to be in the order of $20 US 1995 per barrel, recent years have recorded a downward trend. This trend is illustrated in Figure 5.1 which shows world crude oil price movements since the early 1970's. The decrease in recent years is attributed to decreased world oil demand, and excess supplies from both OPEC and non-OPEC producers.

This figure shows that except for times of crisis such as the Yom Kippur war, the Iranian revolution, and the Iraqi invasion of Kuwait, crude oil prices have tended around the $20 US level in real terms. The above noted downward trend since mid 1992 is shown, with some recovery over the past year.

It is noted that the crude oil price decline experienced over the past 2 to 3 years, in US dollar terms, has been somewhat offset when viewed in terms of Canadian dollars. This results from a decline in the value of Canadian currency versus that of the USA. In fact, while US dollar prices have declined over the period in question by 32 percent, Canadian dollar prices have declined by only 18 percent. This has served to benefit Canadian producers that sell their products in international export markets, thus balancing some of the negative effects of the world crude price decline.

5.1.2 Petroleum Product Prices - Canada

To show how petroleum product prices in Newfoundland compare with those in other provinces, Table 5.1 provides average retail prices for regular unleaded gasoline, automotive diesel fuel, and furnace oil, as of October 17, 1995.

Of the major centres in Canada, consumers in St. John's paid the highest price for gasoline and automotive diesel. The lowest price for these transportation fuels was in Calgary. Prices in Calgary reflect an Alberta market place that is characterized by its own source of supply, a very competitive market environment with the presence of independent retailers, and the lowest provincial tax in the country. Conversely, Newfoundland has no domestic source of supply, no independent suppliers, and a higher tax rate than other Canadian provinces.

Furnace oil prices ranged from a high of 42.7 cents per litre (cpl) in Winnipeg to a low of 32.5 cpl in Halifax. Consumers in St. John's paid 39.1 cpl. The non availability of furnace

oil prices in Calgary and Regina is attributed to the fact that natural gas is the primary heating source in the western provinces.

5.1.3 Petroleum Product Prices - Newfoundland

Figure 5.2 graphically illustrates the movement in gasoline, automotive diesel, and furnace fuel prices for St. John's over the period September 1994 to September 1995. Regular unleaded gasoline prices remained unchanged throughout the fall of 1994 but subsequently decreased 2.0 cpl in response to decreasing crude oil costs and an international softening of gasoline prices.

Apart from a 1.5 cents per litre increase in the federal excise tax, following February's federal budget, prices remained stable throughout January 1995 to the last week in April 1995. At that time prices increased by 4.5 cpl in the St. John's market. Smaller increases occurred throughout the remainder of the Island. This increase was also felt in petroleum product markets across Canada.

The increase was in response to several international factors including a strengthening demand for gasoline combined with inadequate supplies, an increase in crude oil prices, and, technical factors relating to the removal of butane during the refining process that helps to minimize vaporization in summer gasoline.

Gasoline prices decreased throughout August and September 1995. At the end of September, the average price for self serve regular unleaded was 62.9 cpl, a decrease of 3.0 cpl from the 65.9 cpl recorded for July.

In contrast to the retail gasoline market where price fluctuations commonly occur, retail automotive diesel and furnace oil prices remained relatively stable. In particular, as shown in Figure 5.2, furnace oil prices did not change throughout the period under review. The reason for this can be attributed to the individuality of these different markets and the approach taken by oil companies to maintain or increase market share in these areas.

For instance, road diesel is mainly offered under contract terms where, depending on the volumes purchased, significant discounts can apply. During periods of price instability, oil companies will often adjust these discounts in an effort to maintain or gain market share. Unfortunately, this discount information is confidential and could not be available for their report.

Unless there are significant and sustained changes to crude costs, furnace oil prices will tend to remain relatively stable throughout the short term. A contributing factor to this stability is the automated delivery and payment schedules offered by oil companies. Customers can budget their finances by spreading their heating fuel costs over a twelve month period. Other factors contributing to the relevant stability of furnace oil prices are companies are wary of losing market

share in the face of unstable prices, and they realize that furnace oil must compete with electricity as a space heating fuel.

Further illustration respecting the retail price of petroleum products in Newfoundland is accomplished by comparing the various price components as shown in Figure 5.3. These components include the cost of crude, refining and marketing costs, federal and provincial taxes, and retailer margin. This figure shows that for regular unleaded gasoline, taxes levied by the federal and provincial governments amount to 30.6 cpl, or 49 percent of the current 62.9 cpl price. The cost of crude accounts for another 15.6 cpl, leaving 12.2 cpl for refining, marketing and distribution, and 4.5 cpl for the retailer.

For automotive diesel fuel, taxes represent 24.9 cpl or 37% of the current 67.9 cpl price. The 7% goods and service tax is the only tax applied to furnace fuel.

In addition to the crude cost and tax components, product prices are influenced by the particular circumstances characterizing each market areas. For example, a retailer operating in St. John's with high volume sales can afford to keep a low margin. This may not be the case in certain rural areas where sales volumes are lower. In this case, the retailer must therefore increase the margin in order to maintain a reasonable profit. Also, the level of competition and the cost of marketing, distributing, and storing product throughout the province add to the retail price.

5.2 Electricity Prices

5.2.1 The Public Utilities Board

The Board of Commissioner's of Public Utilities of the Province of Newfoundland (Public Utilities Board, or PUB) is the regulatory body for electrical utilities under provincial jurisdiction. The PUB's powers and responsibilities in this regard are defined by The Public Utilities Act and the Electrical Power Control Act.

The PUB, through the Minister of Natural Resources, can regulate all prices charged by NP, and any other electrical utilities, except NLH. Such regulation includes the determination of the capital expenditures and other costs that may be considered in the determination of revenue requirements, and what constitutes a fair rate of return on equity.

With respect to NLH, the PUB can recommend to Cabinet the rates charged to its direct retail customers, to NP and to NLH's rural customers, and to Labrador interconnected customers. The rates charged to NLH's industrial customers and the corporation's capital spending are not submitted to the PUB.

5.2.2 Overview - Rates

The rates charged by NLH, excluding sales by subsidiaries, are governed by the Electrical Power Control Act (EPCA). Under this Act, NLH is required to charge rates designed "to recover the forecast cost for that supply of power provided by it and a margin of profit sufficient to achieve and maintain a sound financial position so that it is able to achieve and maintain a sound credit rating in the financial markets of the world".

There are presently four long-tern contracts with industrial customers that were entered into before the coming into force of the EPCA. As a result, in these cases, NLH is unable to apply rates that reflect the above quoted policy. Prior to 1992, the Province paid a subsidy to NLH with respect to these contracts.

Also, the rates charged to NLH's rural customers are not sufficient to recover the full cost of the service provided: however, the resulting deficit is recovered from other customers.

Determination of the rate charged for electricity in Newfoundland and Labrador involves consideration of numerous factors including, existing legislation; taxes; customer type-residential, commercial, or industrial; location - Island or Labrador, rural or interconnected; decisions by NLH, the PUB, the provincial Cabinet, and NP; and the amount of electricity consumed. A detailed description of the interrelationships of all of these factors is beyond the scope of this report.

To illustrate the general level of electricity rates, NP's rates in St. John's are compared with those for select locations across Canada. Selected examples of consumption levels are provided to illustrate the electricity price differentials. For large industrial customers, the comparison is accomplished by referencing select utilities. Following these comparisons, the rates for NLH's Island and Labrador customers, are discussed.

An important mechanism employed by NLH to reduce volatility in electricity prices is the rate stabilization plan. Because electricity prices are significantly influenced by water levels and crude oil prices, NLH, in 1986, introduced this plan to help manage the variation in prices from time to time. The net effect being the avoidance of extreme fluctuations in monthly electricity bills. Adjustments to the rate stabilization plan are recalculated on July 01 of each year, to reflect the accumulated balance in the account, and any change in rates.

5.2.3 NP Electricity Rates

NP has 6 rate classes: one for residential usage, four for general usage, referred to as general service customers, and a sixth rate for street and area lighting. Of the four general service classes, there are two small general service classes, one for customers that consume less than 10

kW and the other for customers consuming between 10 kW and 100 kW (110 kVa). The other two general service classes apply to customers that consume between 110 kVa (100 kW) and 1,000 kVa (referred to as medium general service customers), and to customers who consume more than 1,000 kVa (referred to as large general service customers). The power ranges referenced are not the only factors determining rates. Two other important factors, are level of consumption and load (peak demand). To further facilitate comparison, the consumption, and load factors employed are intended to reference standard industry averages. It is noted that the power ranges referenced above are not necessarily the same for all utilities. It is for this reason that the rate comparisons cited reference a specific volume of power.

The rates paid by the residents and businesses of Newfoundland are compared to those of other provinces in Table 5.2-5.9.

While there is no hard-and-fast rule for classifying the type of customer, industrial customers are typically referenced as consuming more than 20,000 kW and falling under NLH's rate structure.

Table 5.2 shows residential electricity prices across Canada as of May 1, 1995. Winnipeg experiences the lowest cost per kilowatt for residential customers at 6.52 cents. Residential consumers in Charlottetown, Prince Edward Island pay the highest prices in Canada at 11.66 cents per kilowatt. The price at St. John's is 8.70 cents per kilowatt or, 0.29 cents per kilowatt hour above the 8.41 cents Canadian average.

The electricity rates for two levels of small general service customers are shown in Table 5.3. With respect to the first small category, Vancouver has the cheapest rates at 8.04 cents per kilowatt hour. The highest rates in this category were experienced by businesses in Charlottetown at 17.66 cents per kilowatt hour. Businesses in St. John's, paid 13.19 cents per kilowatt hour, third highest of all major centres surveyed.

Comparison of the second rate class in the small general service category, shows that businesses in Winnipeg pay the lowest price at 6.69 cents per kilowatt hour, while businesses in Charlottetown pay 13. 81 per kilowatt hour, highest in the country. Businesses in St. John's paid 10.92, 1.11 cents per kilowatt hour higher than the Canadian average of 9.81 cents per kilowatt hour.

Electricity prices for the medium general service rate category shows businesses in St. John's paying 9.88 cents per kilowatt hour, 0.08 cents per kilowatt hour lower than the Canadian average. Vancouver businesses pay the lowest cost for electricity at 6.86 cents per kilowatt hour; while businesses in Regina pay the highest per kilowatt hour at 13.36.

The fifth rate class is the large general service category of customers. Here, Winnipeg is shown with the lowest rates of all centres surveyed; while Charlottetown businesses pay the most

for electricity. Businesses in St. John's paid 0.71 cents per kilowatt hour less than the Canadian average of 7.12 cents.

The sixth category provided by NP is for street and area lighting service. NP provides various fixtures and lighting types to municipalities and businesses. With 40 different options in the street and lighting service category, rates for these services depend on the particular features and equipment types selected. They are not detailed in this report.

5.2.4 Industrial Electricity Rates

The comparison of industrial sector electricity rates illustrated in Table 5.4 shows that Manitoba Hydro charged the lowest at 3.06 cents per kilowatt hour while Ontario Hydro charged 6.3 cents per kilowatt hour. NLH charges its customers 3.64 cents per kilowatt hour, significantly below the Canadian kilowatt hour average of 4.28 cents.

5.2.5 NLH Island and Labrador Electricity Rates

NLH is also responsible for providing electricity to residents and businesses of Labrador and to rural customers on the Island not serviced by NP. A distinction in the rate classes offered by NLH in this regard is made between interconnected and non interconnected service. Here NLH has five service classifications. These are defined as follows; Island Interconnected, Happy Valley/Goose Bay and Northwest River Interconnected, Wabush Interconnected, Labrador City Interconnected, and Island and Labrador Diesel (Rural). NLH also provides street and area lighting for businesses and municipalities not serviced by NP. As in the case of NP, rates for this service are based on the fixtures and equipment types selected.

Tables 5.5 to 5.9 present the domestic and general service categories and rates applicable to each of NLH's classes of service. It can be seen from the rate schedules that the prices charged are largely a function of demand, with rates decreasing as consumption increases. It is noted that Island Interconnected customers of NLH pay the same rates for electricity as NP customers.

Another point of interest is the rates charged under the Labrador Interconnected service. Because this service is provided from Churchill Falls, customers in Interconnected communities in Labrador experience some of the lowest electricity prices in the world.

5.3 Alternative Energy Prices

Unlike conventional energy sources where market prices are readily available, estimates of alternative energy prices are obtained by referencing their various supply costs. These supply

costs include estimates of capital, operations, and maintenance costs as well as a component for return on investment.

There are few data sources that provide reliable alternative energy prices, particularly for Newfoundland and Labrador. However, the National Energy Board has reported a range of supply costs for alternative energy forms in comparison to conventional forms for Canada (see Figure 5.4). Since the various factors involved produce a large variability in supply cost estimates, a range has been provided for each technology. It is noted that while the ranges shown provide a reasonable indication of relative prices, the abundance of hydraulic energy sources in Newfoundland means that electricity prices in the province likely tend toward the lower end of the ranges shown.

6. OIL AND GAS

6.1 Offshore

6.1.1 The CNOPB

The oil and gas resources in the offshore areas adjacent to the province of Newfoundland and Labrador are managed by the Canada-Newfoundland Offshore Petroleum Board (CNOPB) on behalf of the Canadian federal government and the Government of Newfoundland and Labrador. The Board's authority is derived from the legislation implementing the 1985 Atlantic Accord which provides for joint federal/provincial management of the adjacent offshore hydrocarbon resources. The province's onshore oil and gas resources are managed directly by the Government of Newfoundland and Labrador through the Department of Natural Resources.

The CNOPB's responsibilities include issuing offshore petroleum exploration and development rights, archiving exploration data, assessing petroleum resources and reserves potential, and regulating offshore exploration, development and production activities. The latter responsibility involves approving benefits and development plans and monitoring offshore operations to ensure compliance with approved personnel safety plans, environmental protection plans, and other government regulations. This also includes the critical responsibility of ensuring that fields are developed in a way that avoids waste and maximizes resource recovery.

6.1.2 Exploration History

Since the first well was spudded in 1966, 140 wells have been drilled and about 600,000 line kilometres of seismic data have been collected in the Newfoundland and Labrador offshore. Figure 6.1 summarizes exploration activities over the years.

This exploratory effort has resulted in 21 significant hydrocarbon discoveries; 5 on the Labrador Shelf and 16 on the Grand Banks (see Table 6.1). For offshore Labrador the total discovered recoverable resources (expressed at a 50 percent probability of occurrence) are 4.2 trillion cubic feet of natural gas, and 123 million barrels of natural gas liquids. For the northeast Grand Banks region, total discovered recoverable resources are 1.6 billion barrels of oil, 4.0 trillion cubic feet of natural gas, and 237 million barrels of natural gas liquids. Ultimately the development of these resources depends on many factors, the most obvious being crude oil and gas prices. The depressed nature of these prices in recent years explains much of the dramatic downturn in exploration since 1988.

While there has not been any exploration drilling activity in the east coast offshore since 1991, an important recent development was the acquisition of approximately 5,000 km of offshore seismic along the western coast of Newfoundland during 1991 and 1992.

6.1.3 Offshore Land Holdings

The status of offshore land holdings at March 31, 1994 is shown in Table 6.2. The total area held by industry under licence is approximately 2.6 million hectares. In addition, exploration rights covering 2.0 million hectares south of St. Pierre and Miquelon are held by Mobil, Gulf and Imperial Oil under exploratory permits issued by the federal government in 1967 and 1971 (see Figure 6.2). These interest owners will be given the opportunity to convert their permits to exploration licences under the Atlantic Accord legislation after the location of the Newfoundland/Nova Scotia offshore boundary has been determined. The CNOPB announced, on October 3, 1995, that AMOCO Canada was the successful bidder for Parcel No. 1 (see Figure 6.2) with a bid of $90.3 Million and that Husky Oil and Murphy Oil were successful in a joint bid for Parcel No. 2 with a bid of $5.5 million. Exploration Licences will be issued for each of these parcels early in January 1996.

6.1.4 Hibernia

The Hibernia field is located approximately 315 kilometres east southeast of St. John's, Newfoundland. The field's location and development scheme are illustrated in Figure 6.3. Some select parameters characterizing the Hibernia production platform are provided in Table 6.3.

The area of the field approved for development is estimated to contain two billion barrels, of which 666 million barrels are estimated to be recoverable at a 50 percent probability level.

Hibernia represents a new industry for Newfoundland that promises to continue for the next 20 years and beyond. Since construction activities began in 1990, the project has been a source of new investment and employment for the Newfoundland economy. The effects of Hibernia are felt in many communities in Newfoundland and elsewhere in Canada, where the increased incomes to businesses and individuals directly and indirectly involved in this project are improving the local economies.

The current construction schedule sees first oil from Hibernia in December 1997, with final testing and field commissioning occurring over the following six months to July 1998. When the peak production level of 125,000 - 150,000 barrels of oil per day (BOPD) is reached two years later, Hibernia could represent 7 percent to 10 percent of Canada's total volume of light crude oil production.

Oil from Hibernia is characterized by a density of about 32 to 34 degrees API and a sulphur content by weight of .4 to .6 percent. These characteristics are similar to those for West African crudes such as Cabinda and Escavaros. Given these characteristics, and Hibernia's location, it seems that production from Hibernia is likely destined for markets on the U.S. East and Gulf Coasts. The high wax content in Hibernia crude, as represented by a pour point of 12

degrees Celsius, present some difficulties in colder climates. This is one reason that Hibernia crude is less likely to be refined in Canada.

Selected Hibernia project construction activities and milestones between 1994 and full field commissioning in 1998 are summarized below.

Platform Base: The first phase of the platform (GBS) was completed and floated out of the drydock to the deepwater construction site (DWS) in November 1994. The first 2 of 9 slipforming operations at the DWS were completed in February 1995. Operations 3, 4, 5, and 6 were completed in May 1995, operation 7 was completed in July and operation 8 was completed in October 1995; and the final operation is scheduled for March 1996. Fabrication of the components of the platform's four utility shafts has been completed and delivered to Bull Arm. Installation and testing work will take the GBS to completion in November 1996.

Platform Topsides: Construction, assembly, and hookup work characterize the various topsides work activities. These activities relate to 5 supermodules and 7 other modules, referred to as topsides mounted structures (TMS). The wellhead supermodule (M20) was completed and moved from its construction hall at Bull Arm to the adjacent assembly pier in May 1995. The remaining supermodules, mud (M30), process (M10), utility (M40), and quarters/services (M50) have all been delivered to Bull Arm. The east and west drilling derricks (TMS M71/72), have been delivered to Bull arm for assembly and hookup. Also ready for assembly and hookup are the remaining TMS. These are the piperack (M73) - fabricated at Marystown, and the lifeboat stations (M81/82), flareboom (M83), and helideck (M84) - all fabricated at Bull Arm. Final topsides completion is scheduled for November 1996.

Figure 6.4 shows the construction locations for the various modules and illustrates the placement of these modules on the completed platform.

Mating & Tow Out: Mating operations to connect the topsides to the GBS are scheduled to begin in March 1997 with tow out to the field in June 1997.

Production Start: Final ballasting, drilling start, and first production are scheduled for September, August, and December 1997, respectively.

6.1.5 Future Developments

Other Grand Banks development opportunities that exist, in addition to Hibernia include; Terra Nova, Whiterose, and Hebron with discovered resources of 406, 178 and 195 million barrels of recoverable oil, respectively.

Terra Nova

The Terra Nova field, located 22 miles southeast of Hibernia, was discovered in 1984. The K-08 discovery well encountered thick oil-bearing sands which tested oil at a rate of 10,000 BPD. Delineation drilling resulted in upward revisions of the reserve estimates. The five successful delineation wells drilled to date have flow tested at 25,200 BPD, 12,461 BPD, 8,000 BPD, 7,500 BPD, and 5,000 BPD.

Petro-Canada, the operator of the field, has recently increased its share by acquiring Shell's 5.3 percent interest.

Government has held several meetings over the past year with the Terra Nova consortium, lead by Petro-Canada. These discussions are progressing on three fronts and include: fiscal, benefits, and regulatory matters. The companies are currently collecting information for environmental and socio-economic impact statements which will form part of the development plan for the field.

It is very likely that some form of a floating production facility will be used to exploit this field. The companies are considering various alternatives including steel and concrete semisubmersibles and a monohull production vessel. The field should produce for 15 years and up to 12,000 person years of direct employment are expected to be generated in the operations phase alone (800 people for 15 years). If agreement can be reached with the Consortium, a development plan application could be filed by the end of the first quarter, 1996. Under this scenario one could expect first oil production some 3 to 6 years later, indicating first oil in the 1999-2002 timeframe.

Hebron

The Hebron field was discovered in July 1981. Hydrocarbons were recovered from the Hebron I-13 discovery well in five separate intervals, with a combined total flow of 9,070 BPD.

Although further delineation drilling is required to confirm reserve estimates and production rates, a Department of Natural Resources study concluded that the field is a strong candidate for development using a floating production system.

Whiterose

The Whiterose oil field was discovered in 1984 by Husky/Bow Valley. Four delineation wells have been drilled, three of which encountered significant hydrocarbons. The N-22 discovery well in 1984 flowed oil at 900 BPD and gas and condensate at 25 million cubic feet per day and 840 BPD, respectively. The J-49 well flowed oil at 3,000 BPD and gas at 10 million cubic feet per day. The L-61 well tested gas at 24 million cubic feet per day and condensate at 436 BPD. The fourth delineation well - E-09 - drilled in 1987-1988, encountered a thick continuous reservoir that flow-tested 5,000 BPD of oil and 4 million cubic feet per day of natural gas.

The operator, Husky/Bow Valley, estimates that between 200 and 300 million barrels of recoverable oil could be contained within this structure. Husky/Bow Valley has also stated that the relatively compact field geometry and shallow water depth (124 metres) make this field a candidate for development by a floating production system. Further delineation drilling is required to determine the extent of the reservoir.

Other Significant Discoveries

Northern Grand Banks

Twelve additional wildcat wells in the northern Grand Banks area are classified as significant discoveries under the Atlantic Accord Act. Further drilling is required to determine the commercial significance of these discoveries.

Labrador Shelf

The five significant gas discoveries on the Labrador Shelf contain a total of more than 4 trillion cubic feet of natural gas. A study by the Department of Natural Resources concluded that developing these fields will require considerable technology advances, including; developing pipeline trenching technology that protects against iceberg scouring, and refining long distance multiphase flow and metering technologies. Substantial increases in gas prices will also be required. Although commercial development is not anticipated in the near future, advancements in technology and an increased demand for cleaner burning fuels may accelerate the development of these important resources.

6.2 Onshore

6.2.1 Exploration History

The presence of hydrocarbons in western Newfoundland has been recognized for a long time. It is reported that, as early as 1812, a Mr. Parsons skimmed oil from the surface of Parsons Pond to be used as a treatment for rheumatism. The first petroleum exploration well was drilled in 1867 at Parsons Pond by Mr. John Silver. This well reached a total depth of 213 metres and encountered "some oil". No more drilling occurred until 1893 when the Newfoundland Oil Company drilled a 396 metre hole near the old well and struck oil in three different intervals. Several other wells were drilled in this area over the next two decades, most of which encountered oil. Production rates from individual wells were generally between 2 and 10 barrels per day, with total production from this area amounting to about 6,000 barrels.

The discovery of high quality petroleum in western Newfoundland at the turn of the century created quite a stir among local investors. Fuelled by the growing importance of oil as the primary energy source for the machines of the new industrial age, plans were made to develop the infrastructure for a permanent production, refining and distribution business. Unfortunately, the exploration programs, which were conducted on a small scale with limited financial backing, inexperienced labour and poor quality materials, failed to discover adequate reserves and were eventually discontinued.

Small scale exploration programs were also carried out in areas other than Parsons Pond, including; St. Paul's Inlet, Deer Lake and the Port Au Port Peninsula. All of these programs encountered good hydrocarbon shows, but the elusive commercial discovery failed to materialize. It is estimated that about 60 wells have been drilled in western Newfoundland over the years. The most recent well drilled prior to the current phase of exploration, was the Union-Brinex dry hole near the town of Codroy in 1973.

It is encouraging to note that roughly half of the 60 wells drilled encountered some form of hydrocarbons - ie. had "hydrocarbon shows"; and that these, as well as other hydrocarbon occurrences (e.g., in water wells), are geographically widespread.

6.2.2 Onshore Land Holdings

In 1992-1993 the Department of Natural Resources held two land sales and issued petroleum rights to 307,363 hectares of onshore land. The location of these rights are shown in Figure 6.5.

6.2.3 Recent Events/Current Exploration

Since 1988 there has been a renewed interest in western Newfoundland by the petroleum industry. This renewal is the result of a number of factors, including promotional efforts by the Department of Natural Resources to encourage exploration activity, a reinterpretation of the area's geology, and to the petroleum industry's realization that this area had not been properly evaluated using modern technology.

In 1992-1993 Labrador Mining and Exploration Co. Ltd. acquired 93 km of seismic data in the Parsons Pond area. In 1993-1994 Hunt Oil Company and Marathon Petroleum Canada Ltd. acquired 3,300 km of aeromagnetic data in the Port Au Port/Bay St. George area, with Hunt Oil acquiring an additional 87 km of seismic data on the Port Au Port Peninsula.

The current round of onshore exploration is unique in the area's history in that modern exploratory techniques which can effectively map the subsurface are being applied. These efforts have already provided new geological insight and have lead to the identification of drillable prospects, the first of which is now being drilled by Hunt and its partner, Pan Canadian. This well, spudded in September 1994 and named Port Au Port #1, is located on the southwest corner of the Port Au Port peninsula.

On September 10, 1995, Hunt Oil and Pan Canadian commenced drilling a second well. This 3,100 meter well at Long Point on the Port Au Port Peninsula is being directionally drilled from the onshore to Mobil acreage in the offshore area. Hunt and Pan Canadian will pay 100% of the cost of the well as a condition of a farm in agreement with Mobil Oil Canada.

In June of this year, Talisman Energy Inc. of Calgary announced its intention to spud a well before year end, into EL1008, south of the Port Au Port Peninsula. This well will also be directionally drilled from the onshore to the offshore area.

November 19, 1995, International Exploration Consultants (Canada) Inc. (IEXCO) of Calgary commenced a speculative seismic program in the Port Au Port/Stephenville area. The seismic data collected will be available for sale to interested parties.

On November 23, 1995, the Minister of Natural Resources announced a Request for Bids for thirty one parcels throughout western Newfoundland (see Figure 6.6). Bids in the form of work commitments are to be received by March 22, 1996. It is anticipated that the issuance of new exploration permits will result in an increased level of exploration activity in western Newfoundland.

6.3 Petroleum Rights Issuance

The procedures followed by the Province in issuing petroleum rights both offshore and onshore are described in Table 6.4. Rights issuance in the offshore is administered by the CNOPB. The onshore, is directly administered by the Province through the Department of Natural Resources.

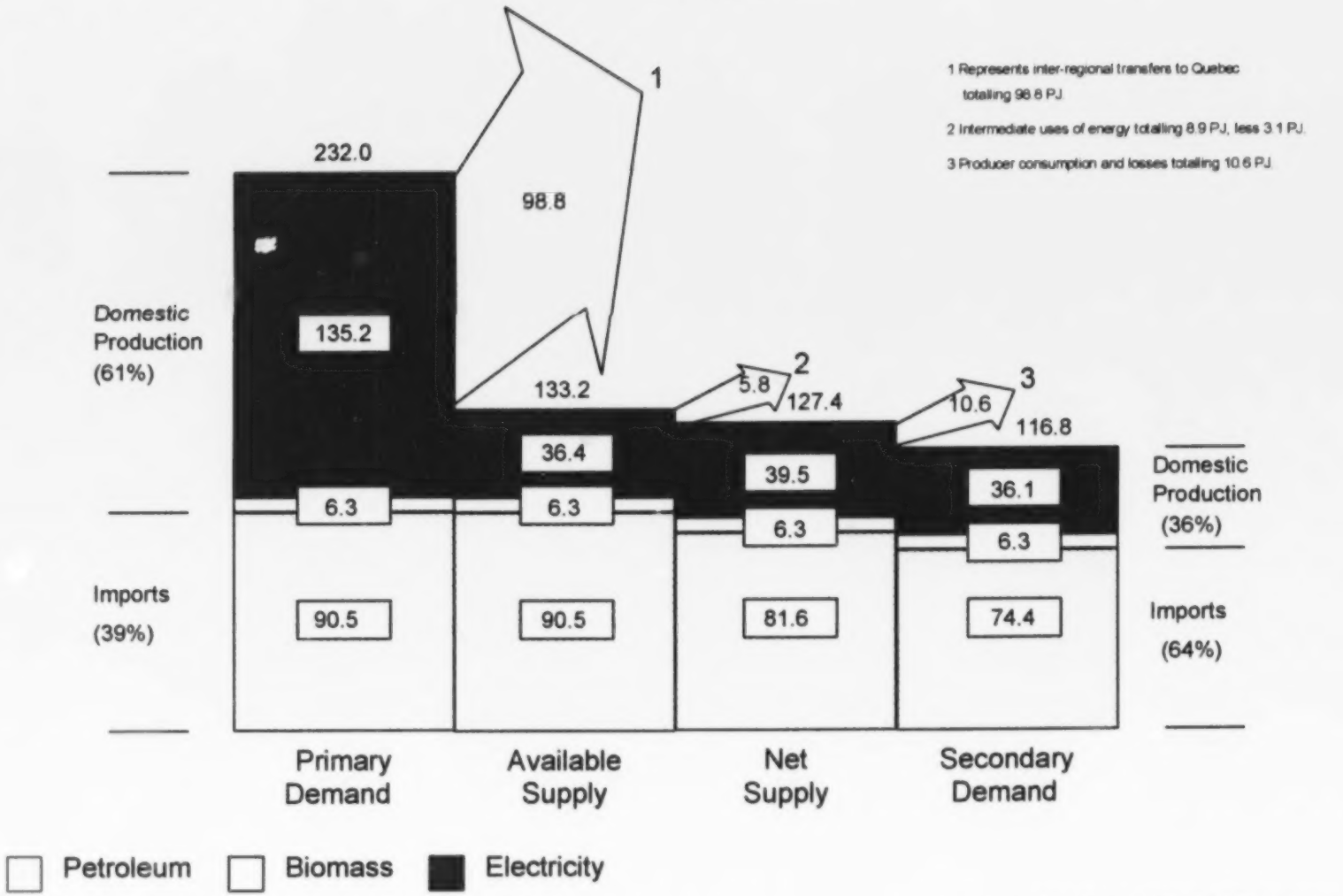
The exploration permit (onshore) and the exploration licence (offshore) provide the exclusive right to drill for but not to produce petroleum. If a field is discovered and appropriate regulatory approval obtained, the rights holder may proceed to the production phase by applying for a "lease" in the onshore area or a "production licence" in the offshore area.

6.4 Petroleum Royalty System

Another important component in the development of the province's petroleum resources is the establishment of a stable fiscal regime. To this end, the Minister of Natural Resources (formerly Mines and Energy), on June 20, 1994, announced a royalty regime for application to the province's onshore petroleum resources. Also, a regime for the province's offshore petroleum resources is currently being developed. These regimes are designed to be sensitive to the level of risks, to be competitive with other jurisdictions, and to provide for a fair sharing of revenues.

TABLES AND FIGURES

Figure 2.1
Newfoundland Energy Flows - 1994
(petajoules)



Source: Nfld. Dept. of Natural Resources

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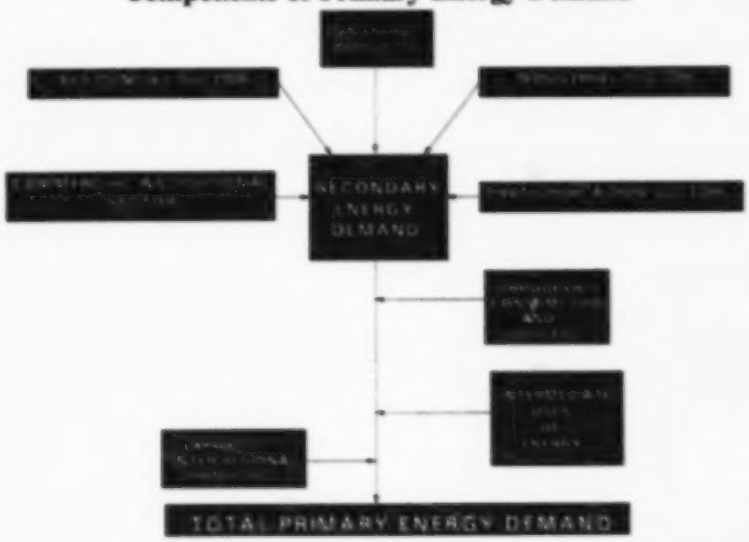
Figure 2.2
Components of Primary Energy Demand



Source: Nfld. Dept. of Natural Resources

Table 2.1
Newfoundland Primary Energy Demand
1993-1994

	1993		1994		Percentage Change
	PJ	BOE	PJ	BOE	1993-1994
Secondary Energy Demand	116.5	30	116.8	30	0.3
Supply Industry Use					
Producer Consumption & Losses	21.1		11.3		
Intermediate Energy Use (Net)	12.4		5.8		
Residual[1]	(.7)		(.7)		
Subtotal	32.8	6	16.4	3	-50.0
Exports/Inter-Regional Transfers	107.8	49	98.8	45	-8.3
TOTAL PRIMARY DEMAND	**257.1**	**85**	**232.0**	**77**	**-9.8**

Note: PJ = Petajoules. BOE = Barrels of Oil Equivalent (Millions).

1. In dealing with energy statistics, supply and demand may not balance. This is attributed to a number of factors, including inventory changes and differences amoung data sources in estimating such components as electricity line losses, and the procedures and factors used to convert one form of energy to another. The residual category is included here to account for these factors.

Source: Statistics Canada, Catologue 57-003.
Nfld. Dept. of Natural Resources.

Table 2.2
Newfoundland Secondary Energy Demand
By Sector and Fuel
1993-1994

Sector	Energy Form	1993 PJ	1994 PJ	Percentage Change 1993-1994
Residential	Petroleum Products	9.574	8.868	-7.4
	Electricity	11.608	11.905	2.6
	Wood	6.0	6.0	0.0
	Total	**27.182**	**26.773**	**-1.5**
Commercial/Institutional	Petroleum Products	4.435	4.299	-3.1
	Electricity	7.155	7.163	0.1
	Wood	0.070	0.070	0.0
	Total	**11.660**	**11.532**	**-1.1**
Industrial	Petroleum Products	14.241	14.302	0.4
	Electricity	16.474	17.025	3.3
	Wood	0.391	0.242	-38.1
	Coke & Coal	1.918	3.331	73.7
	Total	**33.024**	**34.900**	**5.7**
Transportation	Petroleum Products	43.496	42.519	-2.2
	Total	**43.496**	**42.519**	**-2.2**
Total Energy Demand	Petroleum Products	71.746	69.988	-2.5
	Electricity	35.237	36.093	2.4
	Wood	6.461	6.312	-2.3
	Coke & Coal	1.918	3.331	73.7
	Non-Energy Products	1.133	1.076	-5.0
	TOTAL	**116.495**	**116.800**	**0.3**

Source: Statistics Canada, Catalogue 57-003.
Nfld. Dept. of Natural Resources.

Figure 2.2
Components of Primary Energy Demand

Source: Nfld. Dept. of Natural Resources

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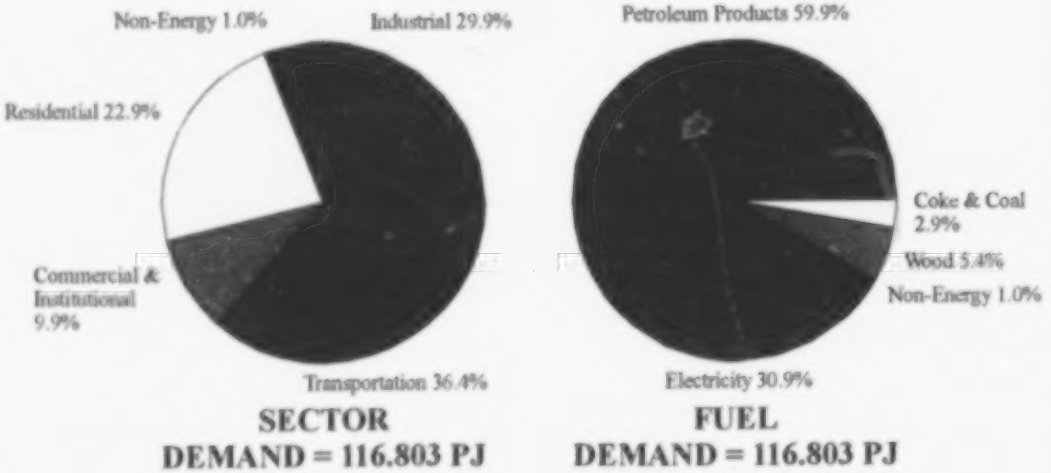
Source: Statistics Canada, Catologue 57-003.
Nfld. Dept. of Natural Resources.

Figure 2.3
Newfoundland Secondary Energy Demand
Percentage Distribution - 1994 By Sector and Fuel



Source: Nfld. Dept. of Natural Resources

Table 2.3
Newfoundland Secondary Energy Demand
Petroleum Product Demand By Fuel
1993-1994

Fuel Type	1993		1994		Percentage Change 1993-1994
	PJ	BOE	PJ	BOE	
Motor Gasoline	20.741	3,766,218	20.564	3,734,079	0.9
Kerosene and Stove Oil	1.602	267,579	1.420	237,180	-11.4
Diesel Fuel Oil	16.758	2,726,755	16.345	2,659,554	-2.5
Light Fuel Oil	11.331	1,843,708	10.521	1,711,910	-7.1
Heavy Fuel Oil	11.844	1,786,222	12.466	1,880,027	5.2
Aviation Gasoline	0.087	16,334	0.084	15,771	-3.4
Aviation Turbo Fuel	8.387	1,468,775	7.934	1,389,444	-5.4
Gas Plant N.G.L.'s	0.996	230,628	0.654	151,436	-34.3
TOTAL	**71.746**	**12,106,219**	**69.988**	**11,779,401**	**-2.5**

Source: Statistics Canada, Catologue 57-003.
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Table 2.4
Newfoundland Secondary Energy Demand
Residential Sector
1993-1994

FUEL TYPE	1993 PJ	1994 PJ	PERCENTAGE CHANGE 1993-1994
Kerosene and Stove Oil	1.230	1.089	-11.5
Light Fuel Oil	8.048	7.590	-5.7
Gas Plant N.G.L.'s	0.296	0.189	-36.1
Petroleum Products	9.574	8.868	-7.4
Electricity	11.608	11.905	2.6
Wood	6.000	6.000	0.0
TOTAL	**27.182**	**26.773**	**-1.5**

Source: Statistics Canada, Catologue 57-003.
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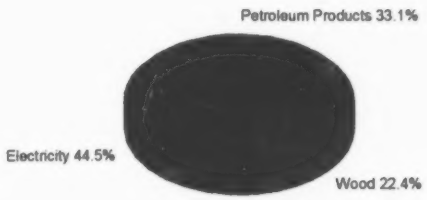
Figure 2.4
Newfoundland Secondary Energy Demand
Distribution of Residential Sector Demand - 1994



DEMAND = 26.773 PJ
Source: Nfld. Dept. of Natural Resources

Table 2.5
Newfoundland Secondary Energy Demand
Commercial/Institutional Sector
1993-1994

FUEL TYPE	1993 PJ	1994 PJ	PERCENTAGE CHANGE 1993-1994
Kerosene and Stove Oil	0.320	0.258	-19.4
Light Fuel Oil	2.777	2.380	-14.3
Heavy Fuel Oil	0.947	1.385	46.3
Gas Plant N.G.L.'s	0.391	0.276	-29.4
Petroleum Products	4.435	4.299	-3.1
Electricity	7.155	7.163	0.1
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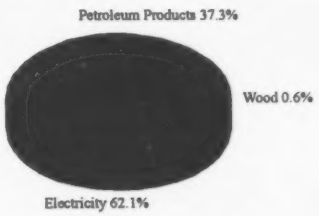
Figure 2.5
Newfoundland Secondary Energy Demand
Distribution of Commercial Sector Demand - 1994



DEMAND = 11.535 PJ
Source: Nfld. Dept. of Natural Resources

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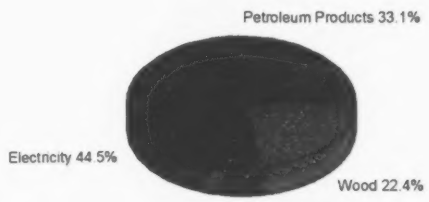
Distribution of Residential Sector Demand - 1994



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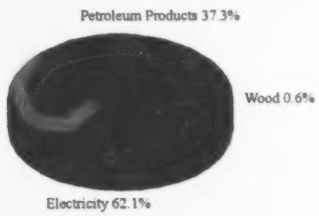

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Newfoundland Secondary Energy Demand
Industrial Sector
1993-1994

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Electricity	16.474	17.025	3.3
Wood	0.391	0.242	-38.1
Coke & Coal	1.918	3.331	73.7
TOTAL	**33.024**	**34.900**	**5.7**

Source: Statistics Canada, Catologue 57-003.
Nfld. Dept. of Natural Resources.

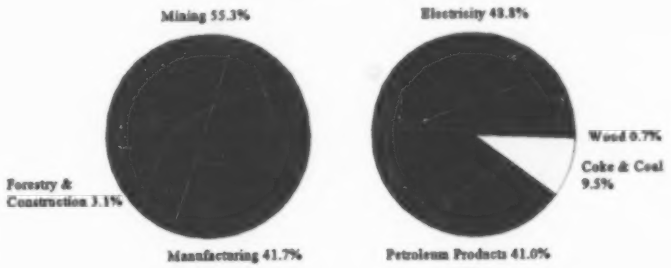
Table 2.7
Newfoundland Secondary Energy Demand
Industrial Subsector and Fuel
1994

	MINING	MANUFACTURING	FORESTRY & CONSTRUCTION[1]	TOTAL
Electricity	7.819	9.206	-	17.025
Petroleum	8.136	5.096	1.070	14.302
Wood	-	0.242	-	0.242
Coke and Coal	3.331	-	-	3.331
TOTAL	**19.286**	**14.544**	**1.070**	**34.900**

[1] Includes 0.075 PJ of diesel fuel consumed by the agriculture industry.

Source: Statistics Canada, Catologue 57-003.
Nfld. Dept. of Natural Resources.

Figure 2.6
Newfoundland Secondary Energy Demand
Distribution of Industrial Sector Demand - 1994



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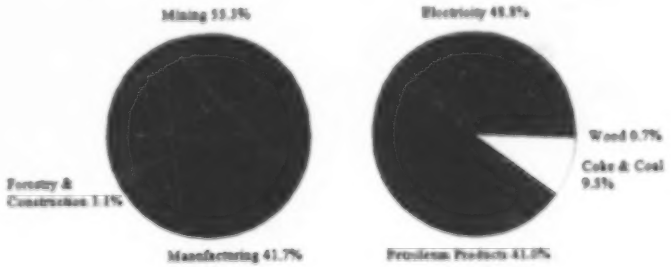

Source: Nfld. Dept. of Natural Resources

Table 2.8
Newfoundland Secondary Energy Demand
Industrial Sector
Mining Sub-Sector
1993-1994

FUEL TYPE	1993 PJ	1994 PJ	PERCENTAGE CHANGE 1993-1994
Kerosene and Stove Oil	0.001	0.001	0.0
Light Fuel Oil	0.121	0.122	0.8
Diesel Fuel Oil	1.405	1.384	-1.5
Heavy Fuel Oil	6.785	6.629	-2.3
Gas Plant N.G.L.'s	0.003	-	-
Petroleum Products	8.315	8.136	-2.2
Electricity	7.078	7.819	10.5
Coke & Coal	1.918	3.331	73.7
TOTAL	**17.311**	**19.286**	**11.4**

Source: Statistics Canada, Catologue 57-003.
Nfld. Dept. of Natural Resources.

Table 2.9
Newfoundland Secondary Energy Demand
Industrial Sector
Manufacturing Sub-Sector
1993-1994

Fuel Type	1993 PJ	1994 PJ	Percentage Change 1993-1994
Kerosene and Stove Oil	0.042	0.028	-33.3
Diesel Fuel Oil	0.543	0.361	-33.5
Light Fuel Oil	0.080	0.196	145.0
Heavy Fuel Oil	3.970	4.391	10.6
Gas Plant N.G.L.'s	0.204	0.120	-41.2
Petroleum Products	4.839	5.096	5.3
Electricity	9.396	9.206	-2.0
Wood	0.391	0.242	-38.1
TOTAL	**14.626**	**14.544**	**-0.6**

Source: Statistics Canada, Catologue 57-003.
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Petroleum Products	8.315	8.136	-2.2
Electricity	7.078	7.819	10.5
Coke & Coal	1.918	3.331	73.7
TOTAL	**17.311**	**19.286**	**11.4**

Source: Statistics Canada, Catologue 57-003.
Nfld. Dept. of Natural Resources.

Table 2.9
Newfoundland Secondary Energy Demand
Industrial Sector
Manufacturing Sub-Sector
1993-1994

FUEL TYPE	1993 PJ	1994 PJ	PERCENTAGE CHANGE 1993-1994
Kerosene and Stove Oil	0.042	0.028	-33.3
Diesel Fuel Oil	0.543	0.361	-33.5
Light Fuel Oil	0.080	0.196	145.0
Heavy Fuel Oil	3.970	4.391	10.6
Gas Plant N.G.L.'s	0.204	0.120	-41.2
Petroleum Products	4.839	5.096	5.3
Electricity	9.396	9.206	-2.0
Wood	0.391	0.242	-38.1
TOTAL	**14.626**	**14.544**	**-0.6**

Source: Statistics Canada, Catologue 57-003.
Nfld. Dept. of Natural Resources.

Table 2.10
Newfoundland Secondary Energy Demand
Industrial Sector
Forestry and Construction Sub-Sectors
1993-1994

Fuel Type	1993 PJ	1994 PJ	Percentage Change 1993-1994
Kerosene and Stove Oil	0.010	0.044	340.0
Diesel Fuel Oil[1]	0.771	0.820	6.4
Light Fuel Oil	0.291	0.198	-32.0
Heavy Fuel Oil	-	-	-
Gas Plant N.G.L.'s	0.015	0.008	-46.7
TOTAL	**1.087**	**1.070**	**-1.6**

1. Diesel fuel includes 0.045 PJ in 1993 and .075 PJ in 1994 consumed by the agriculture industry.

Source: Statistics Canada, Catologue 57-003.
Nfld. Dept. of Natural Resources.

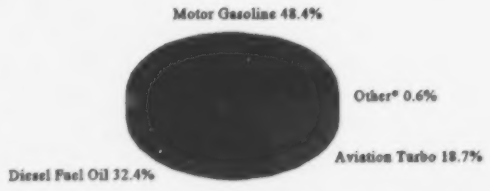
Table 2.11
Newfoundland Secondary Energy Demand
Transportation Sector
1993-1994

FUEL TYPE	1993 PJ	1994 PJ	PERCENTAGE CHANGE 1993-1994
Motor Gasoline	20.741	20.564	-0.9
Diesel Fuel Oil[1]	14.039	13.780	-1.8
Heavy Fuel Oil	0.142	0.061	-57.0
Aviation Gasoline	0.087	0.084	-3.4
Aviation Turbo	8.387	7.934	-5.4
Light Fuel Oil	0.013	0.035	169.2
Gas Plant N.G.L.'s	0.087	0.061	-29.9
TOTAL	**43.496**	**42.519**	**-2.2**

[1] Includes diesel fuel oil consumed in the Public Administration (1.422 PJ) and Commercial and Institutional sectors (2.508 PJ).

Source: Statistics Canada, Catologue 57-003.
Nfld. Dept. of Natural Resources.

Figure 2.7
Newfoundland Secondary Energy Demand
Distribution of Transportation Sector Demand - 1994



DEMAND = 42.52 PJ

* Note: Other here contains the combined percentage of Light Fuel Oil, Heavy Fuel Oil, Gas Plant N.G.L.'s and Aviation Gasoline.
Source: Nfld. Dept. of Natural Resources

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Light Fuel Oil	0.291	0.198	-32.0
Heavy Fuel Oil	-	-	-
Gas Plant N.G.L.'s	0.015	0.008	-46.7
TOTAL	**1.087**	**1.070**	**-1.6**

1. Diesel fuel includes 0.045 PJ in 1993 and .075 PJ in 1994 consumed by the agriculture industry.

Source: Statistics Canada, Catologue 57-003.
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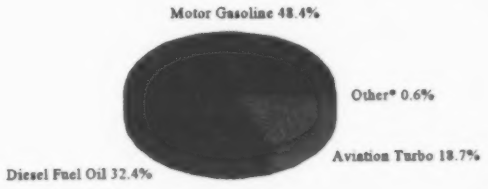


DEMAND = 42.52 PJ

* Note: Other here contains the combined percentage of Light Fuel Oil, Heavy Fuel Oil, Gas Plant N.G.L.'s and Aviation Gasoline.
Source: Nfld. Dept. of Natural Resources

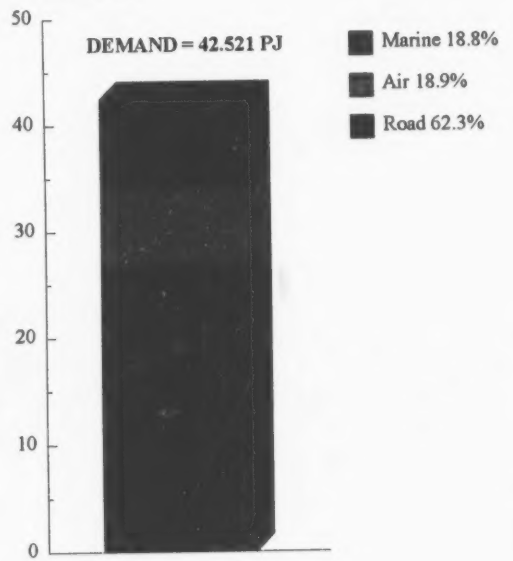
Table 2.12
Newfoundland Secondary Energy Demand
Transportation Subsectors
1993-1994

FUEL TYPE	1993 PJ	1994 PJ	PERCENTAGE CHANGE 1993-1994
Motor Gasoline	20.741	20.564	-0.8
Diesel Fuel Oil	6.005	5.860	-2.4
Gas Plant N.G.L.'s	0.087	0.061	-29.9
Total- Road Subsector	**26.833**	**26.485**	**-1.3**
Aviation Gasoline	0.087	0.084	-3.4
Aviation Turbo	8.387	7.934	-5.4
Total- Air Subsector	**8.474**	**8.018**	**-5.4**
Heavy Fuel Oil	0.142	0.060	-57.7
Diesel Fuel Oil[1]	8.034	7.920	-1.4
Light Fuel Oil	0.013	0.035	169.2
Total- Marine Subsector	**8.189**	**8.015**	**-2.1**

1. Includes consumption within the Marine and Public Administration Subsectors.

Source: Statistics Canada, Catologue 57-003.
Nfld. Dept. of Natural Resources.

Figure 2.8
Newfoundland Secondary Energy Demand
Distribution of Transportation
Sector Demand - 1994
(By SubSector)



Source: Nfld. Dept. of Natural Resources

Table 3.1
Newfoundland & Labrador Electrical Energy
Installed Generating Capacity
1994

	Supply Capacity (MW)			
	NLH[1]	NP[2]	Industry	Total
Labrador				
Hydraulic	5,653	0	18	5,671
Thermal				
Oil	0	0	7	7
Diesel	29	0	3	32
Gas Turbine	25	0	0	25
	5,707	0	28	5,735
Island				
Hydraulic	899	87	187	1,173
Thermal				
Oil	490	30	0	520
Diesel	29	14	0	43
Gas Turbine	123	47	0	170
Wood	5	0	0	5
	1,546	178	187	1,911
Hydraulic	6,552	87	205	6,844
Thermal	701	91	10	802
	7,253	178	215	7,646

1. Newfoundland and Labrador Hydro
2. Newfoundland Power

Source: Newfoundland and Labrador Hydro.
Newfoundland Power.
Nfld. Dept. of Natural Resources.

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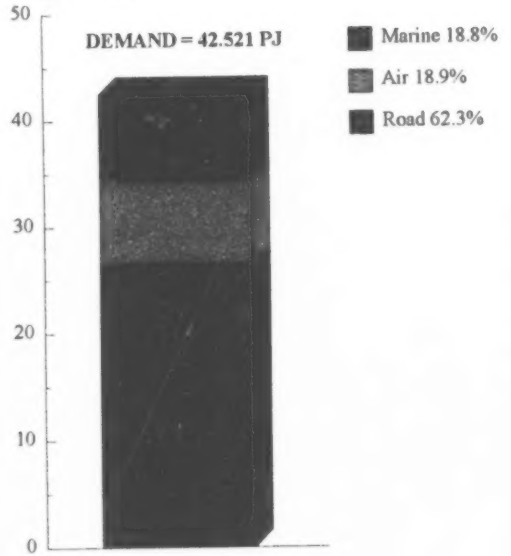

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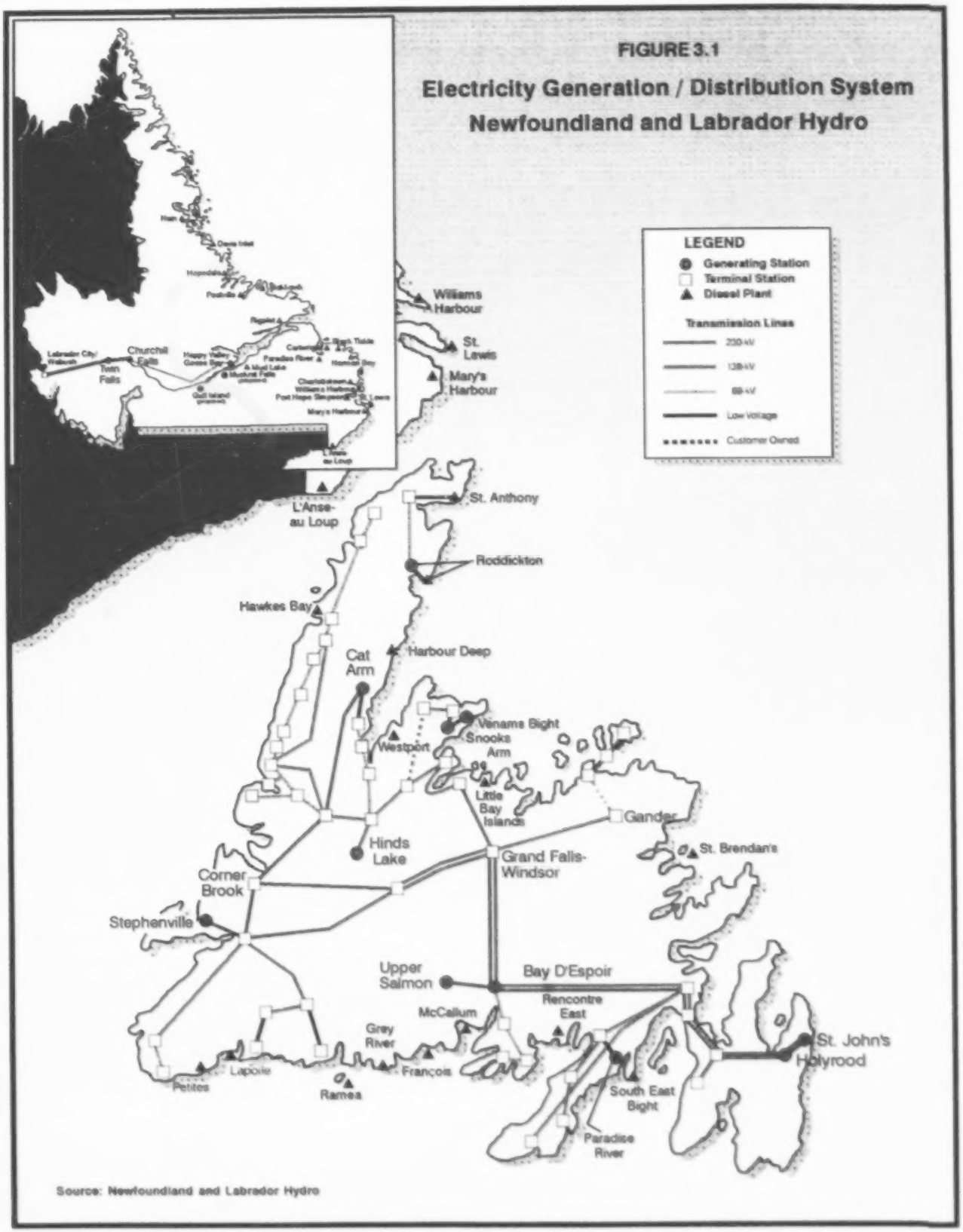
Nfld. Dept. of Natural Resources.

FIGURE 3.1

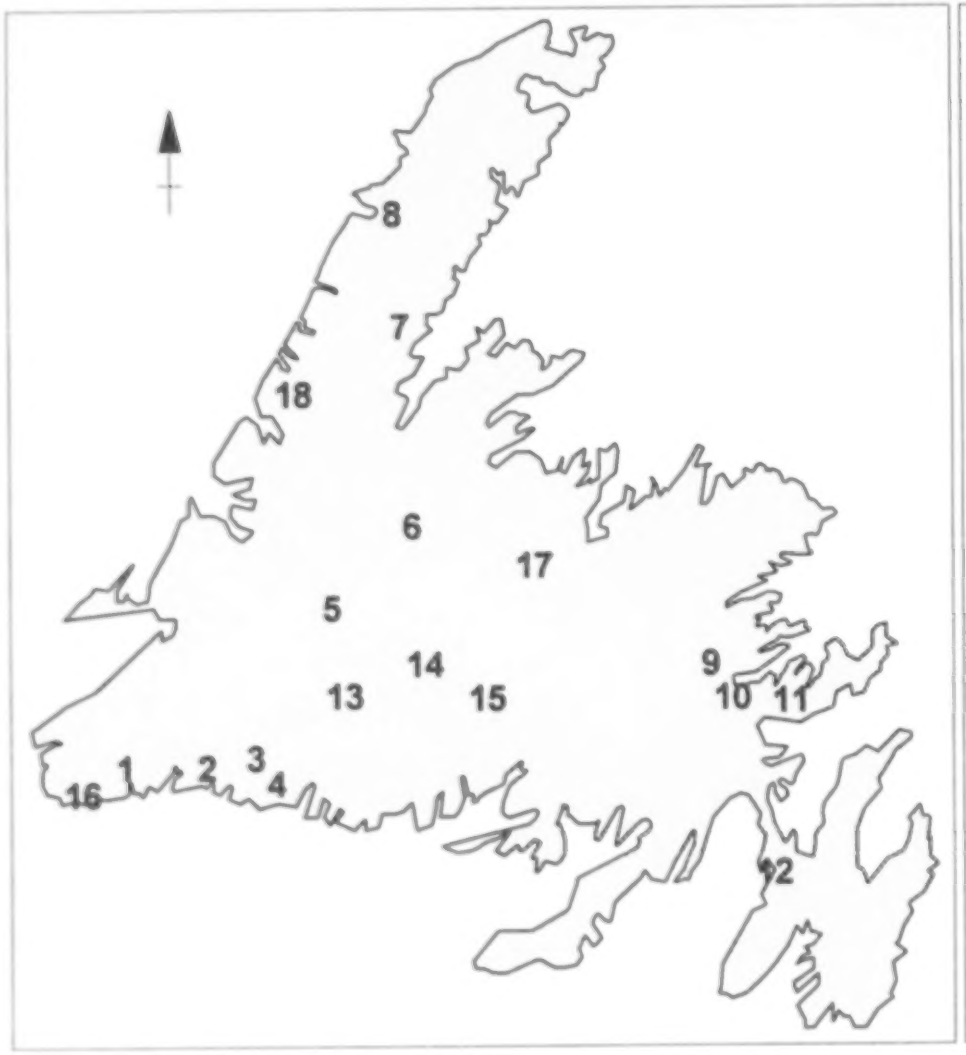
Electricity Generation / Distribution System
Newfoundland and Labrador Hydro



Source: Newfoundland and Labrador Hydro

Figure 3.2

Small Scale Hydraulic Sites
(Select Potential Future Island Developments)



	Installed Capacity MW
NON UTILITY GENERATORS LESS THAN 15 M.W. (NUG'S)	
1. Garia Bay	15
2. Northwest Arm Brook	15
3. Dry Pond Brook	10
4. Kings Harbour River	15
5. Star Lake	15
6. Sheffield Lake	5
7. Rattle Brook	4
8. Torrent River	15
9. Northwest River	12
10. Southwest River	7
11. Lady Pond	0.3
12. Long Harbour (Rattling Brook)	0.5
NEWFOUNDLAND AND LABRADOR HYDRO SITES	
13. Granite Canal	31
14. Island Pond	30
15. Round Pond	18
NEWFOUNDLAND POWER HYDRO SITE	
16. Rose Blanche	5.5
NON UITILITY GENERATORS GREATER THAN 15 M.W.	
17. Greenwood	58
18. Silver Mountian	70
TOTAL	326.3

Source: Newfoundland Department of Natural Resources

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Table 3.2
Energy Efficiency - Select Comparisons
(Consumption Per $1000 GDP)

	TOE per $1000 of GDP at US 1985 prices and exchange rates			Percentage Change	
	1973	1979	1992	73-92	79-92
Total Newfoundland	N/A	0.73	0.69	N/A	-5.5
Select Countries					
Canada	0.55	0.52	0.41	-25.5%	-21.2
USA	0.43	0.39	0.30	-30.2%	-23.1
Japan	0.29	0.24	0.18	-37.9%	-25.0
OECD Total	**0.41**	**0.37**	**0.28**	**-31.7%**	**-24.3**

GDP = Gross Domestic Product
TOE = Tonnes of Oil Equivalent

Source: International Energy Agency.
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Source: International Energy Agency.
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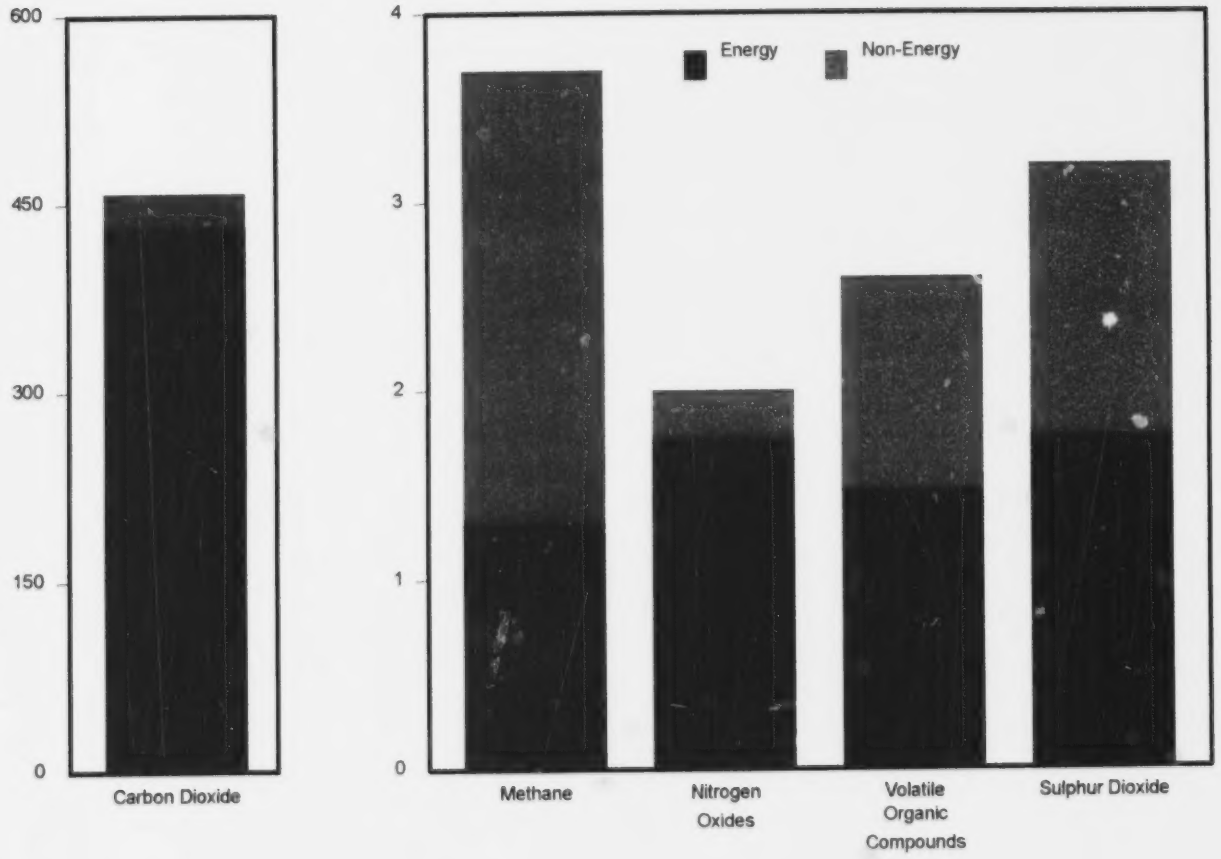
Figure 4.1
Gaseous Emissions from Human Activity in Canada - 1990
(million tonnes)



Source: Canada's Greenhouse Gas Emissions: Estimates for 1990, A.P. Jaques, Environment Canada Report EPS 5/AP/4, December 1992

Preliminary Emissions for 1990, L. Greenwood, Environment Canada, May 1994;

Nfld. Dept. of Natural Resources.

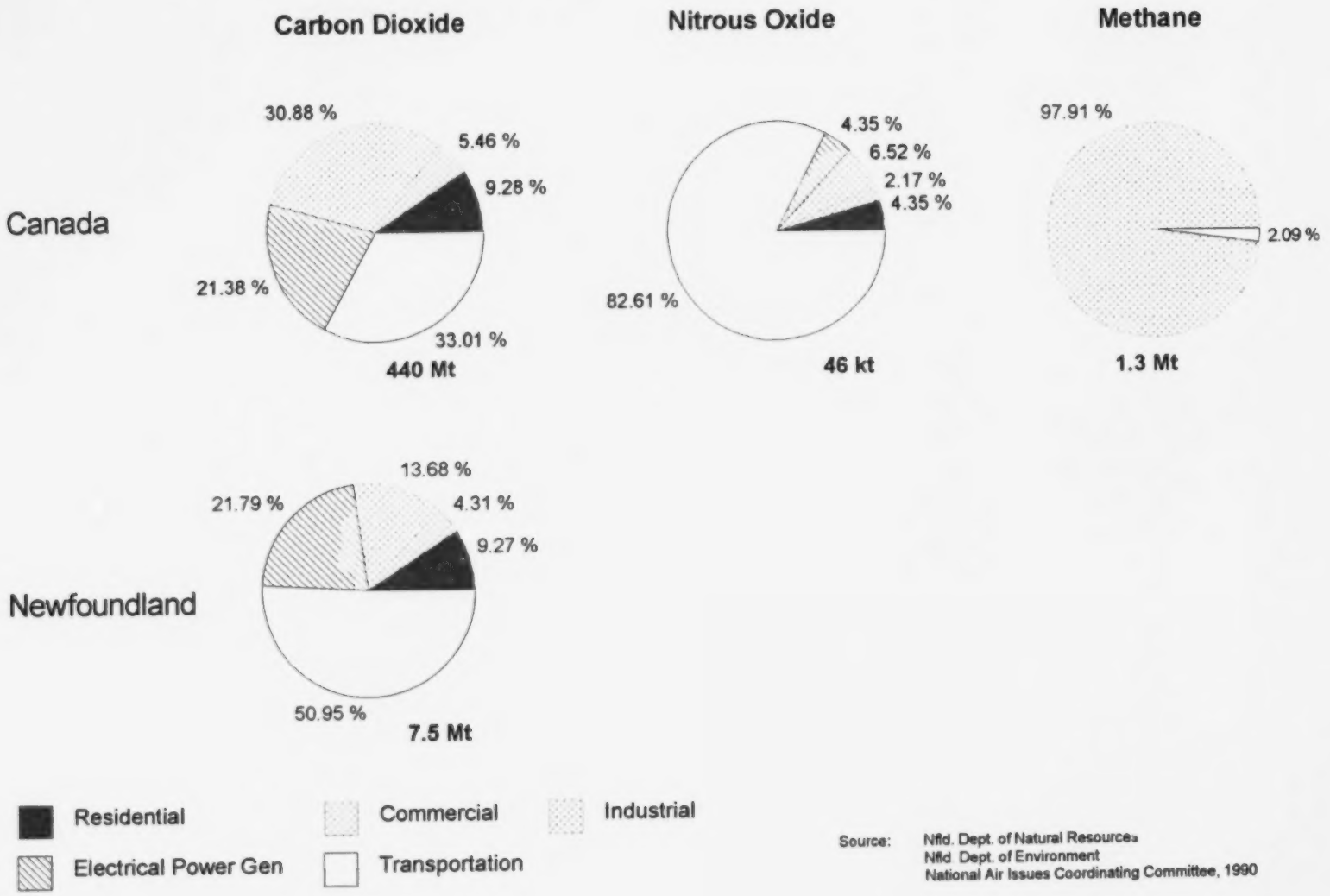
Table 4.1
Gaseous Emissions From Human Activity
Proportional Contributions to Climate Change

	CO_2	CH_4	N_2O	CFC's	Others
Lifetime in Atmosphere (yrs)	40-150	11	132	55-550	Days-80
Global Emissions (Mt/yr)	26,000	300	6	1	300
GWP[1] (100 year)	1	11	270	3400-7000	50-5000+
Proportion of Total Effect (Global)	61%	15%	4%	11%	9%
Canadian Equivalents	70%	13%	4%	9%	4%

1. GWP = Global Warming Potential.

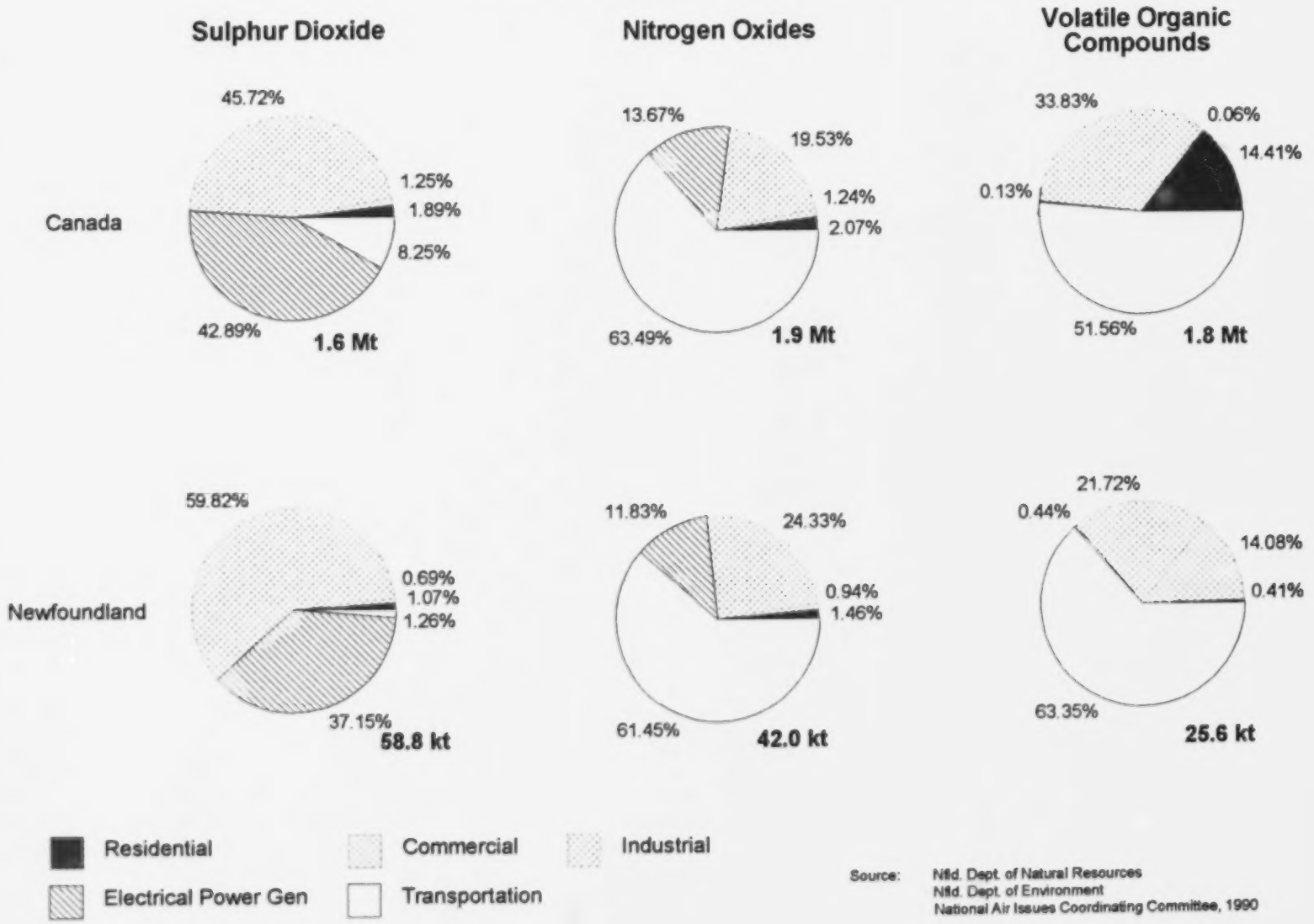
Source: Intergovernmental Panel on Climate Change, "Climate Change 1992". National Energy Board. Canadian Energy Supply and Demand 1993-2010. Nfld. Dept. of Natural Resources.

Figure 4.2
Energy Related Greenhouse Gas Emissions
Canada and Newfoundland, 1990



Source: Nfld. Dept. of Natural Resources
Nfld. Dept. of Environment
National Air Issues Coordinating Committee, 1990

Figure 4.3
Energy Related Common Pollutant Emissions
Canada and Newfoundland, 1990



Source: Nfld. Dept. of Natural Resources
Nfld. Dept. of Environment
National Air Issues Coordinating Committee, 1990

Table 4.2
Energy and the Environment
Summary Comparison - Newfoundland and Canada
Megatonnes
1990

Energy Related Emissions Source	Canada	Nfld	% Nfld/ Canada
Carbon Dioxide (CO_2)	439.11	7.49	1.7%
Methane (CH_4)	1.29	N/A	-
Nitrous Oxide (N_2O)	.05	N/A	-
Sulphur Dioxide (SO_2)	1.30	.06	4.6%
Nitrogen Oxides (NO_x)	1.76	.04	2.3%
Volatile Organic Compounds (VOC)	1.71	.04	2.3%

Source: Intergovernmental Panel on Climate Change, "Climate Change 1992". Nfld. Dept. of Natural Resources.

Figure 5.1
WORLD CRUDE OIL PRICE TRENDS - HISTORICAL
REAL (1995) US $/BBL

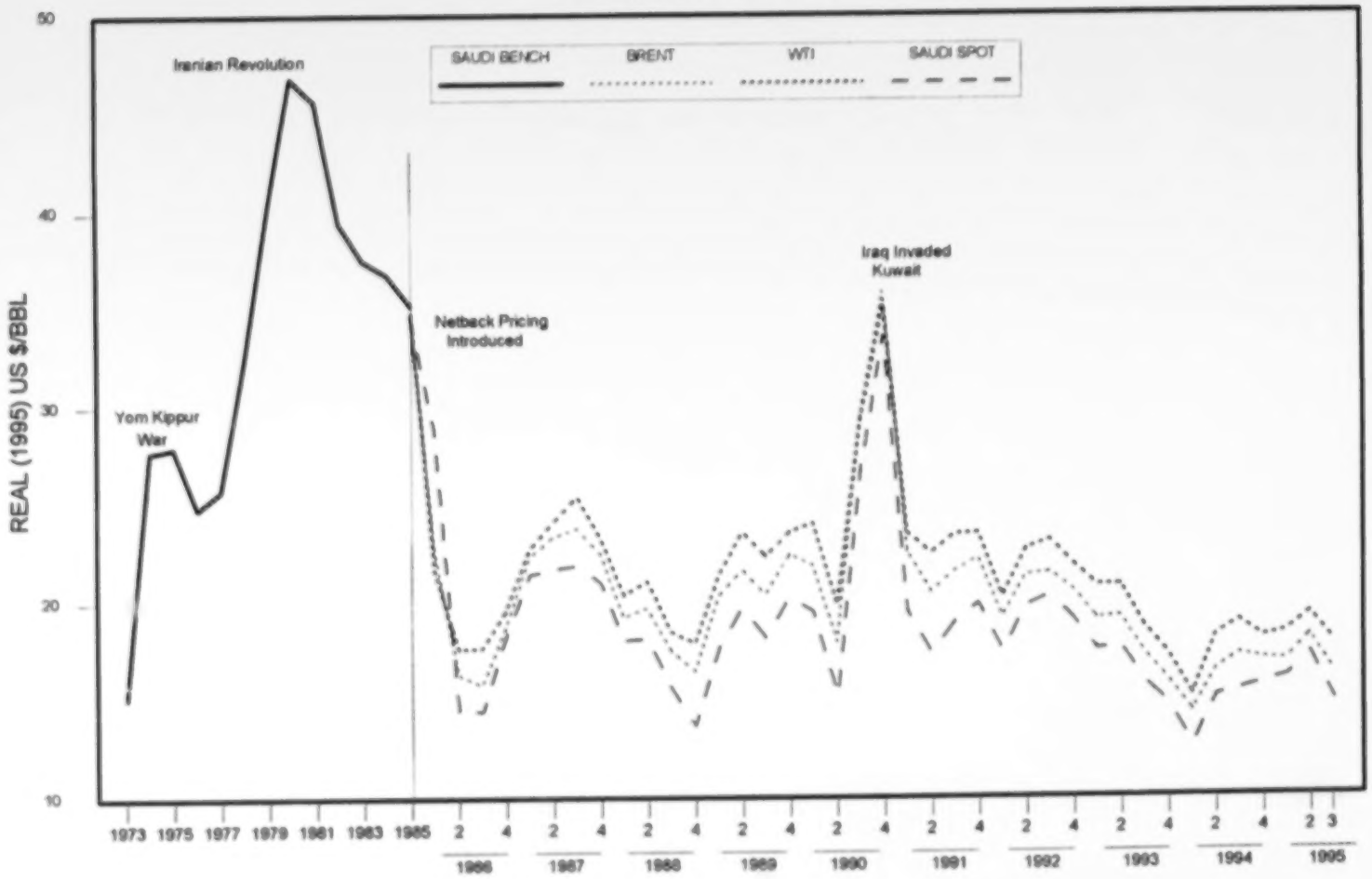


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Table 5.1
Comparative Cost of Petroleum Products
Major Centres - Canada
October 17, 1995

	Regular Unleaded Self Serve	Automotive Diesel Self Serve	Furnace Oil
St. John's	62.9	67.9	39.1
Charlottetown	60.0	59.8	37.7
Halifax	54.5	53.4	32.5
St. John	54.0	57.1	35.7
Montreal	53.0	53.2	38.1
Toronto	52.3	51.3	38.3
Winnipeg	53.8	48.2	42.7
Regina	56.9	49.9	NA
Calgary	49.6	43.8	NA
Vancouver	57.6	51.9	40.9
Canada Average[1]	**53.3**	**50.9**	**37.4**

[1] weighted average.

Source: Natural Resources Canada.
Nfld. Dept. of Natural Resources.

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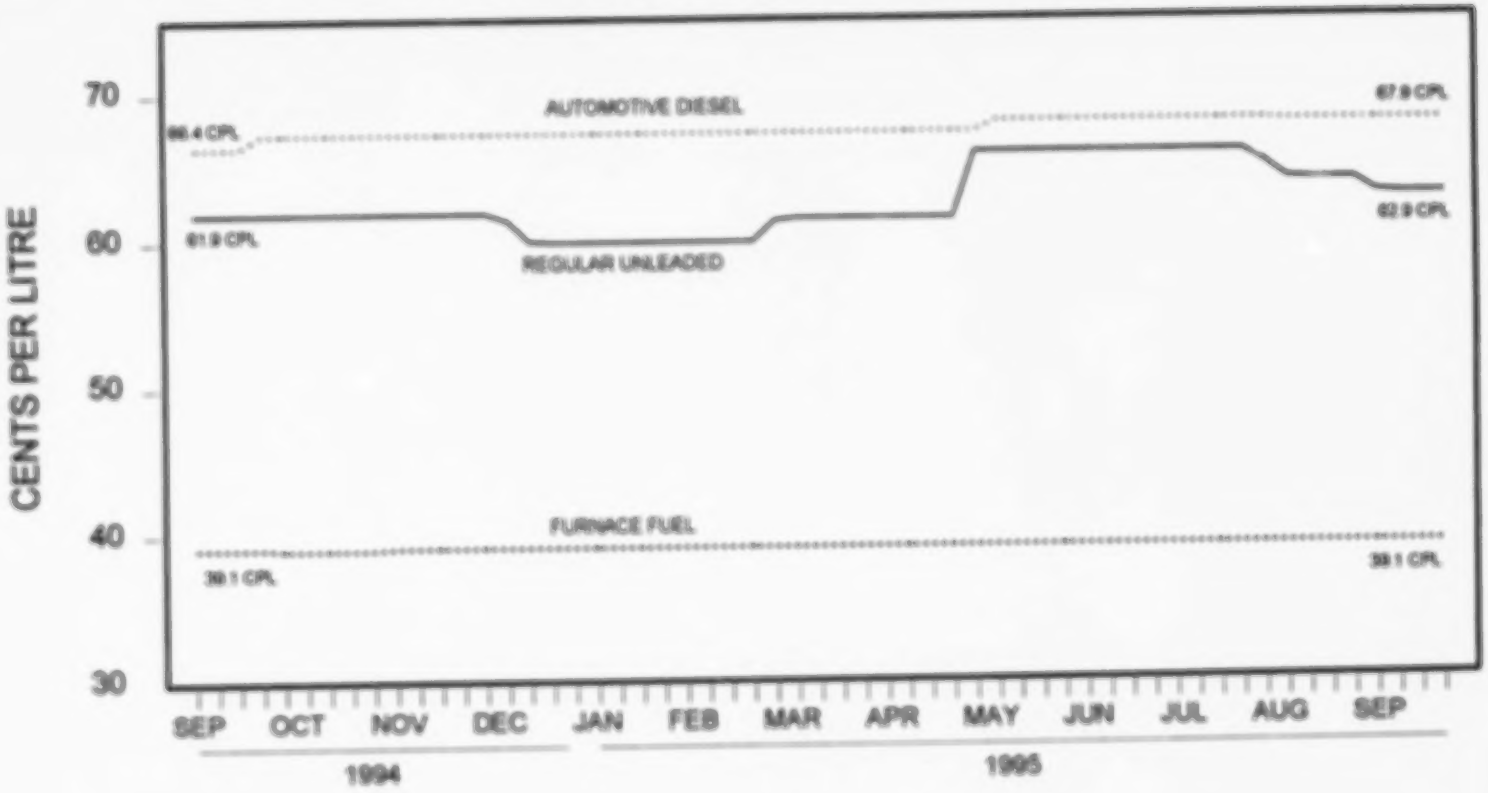
Montreal	53.0	53.2	38.1
Toronto	52.3	51.3	38.3
Winnipeg	53.8	48.2	42.7
Regina	56.9	49.9	NA
Calgary	49.6	43.8	NA
Vancouver	57.6	51.9	40.9
Canada Average[1]	**53.3**	**50.9**	**37.4**

[1] weighted average.

Source: Natural Resources Canada.
Nfld. Dept. of Natural Resources.

Figure 5.2
WEEKLY GASOLINE PRICE SURVEY
AVERAGE PRICES BY FUEL TYPE
SEPTEMBER 1994 - SEPTEMBER 1995

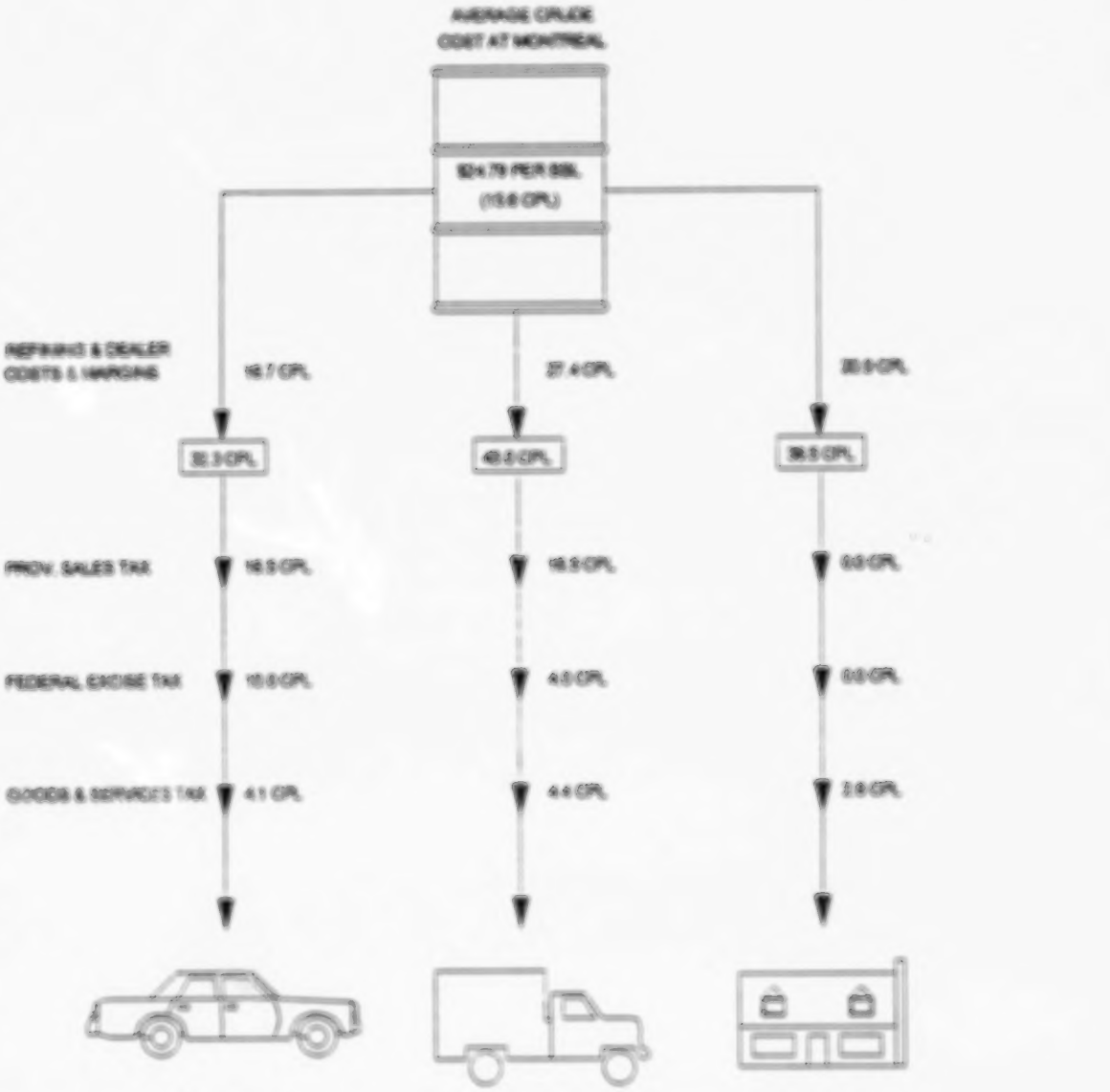


NOTE: AVERAGE PRICE BASED ON 28 STATION SURVEY

SOURCE: DEPARTMENT OF NATURAL RESOURCES

Figure 5.3

COMPOSITION OF SELECTED REFINED PETROLEUM PRODUCT PRICES FOR ST. JOHN'S SEPTEMBER 1995



SOURCE: NATURAL RESOURCES CANADA
NFLD. DEPT. OF NATURAL RESOURCES

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Table 5.2
Residential Electricity Rates Comparison
Including All Taxes
Based on 1,000 kWh Consumption
May 1, 1995

CENTRE	¢/kWh
Vancouver	6.75
Edmonton	7.64
Regina	8.71
Winnipeg	6.52
Toronto	9.96
Ottawa	7.87
Montreal	6.58
Halifax	9.90
Moncton	8.21
Charlottetown	11.66
St. John's	8.70
AVERAGE	**8.41**

Source: Hydro Quebec, 1995 Rates Survey.
Nfld. Dept. of Natural Resources.

Table 5.3

General Service Electricity Rates Comparison

Including All Taxes

¢/kWh

May 1, 1995

	SMALL		MEDIUM	LARGE
Power: Consumption: Load Factor:	6 kW 750 kWh 17%	40 kW 10,000 kWh 35%	500 kW 100,000 kWh 28%	1,000 kW 400,000 kWh 56%
Vancouver	8.04	7.65	6.86	5.20
Edmonton	11.51	9.49	9.27	6.80
Regina	11.51	10.09	13.36	8.68
Winnipeg	9.62	6.69	7.86	5.13
Toronto	15.23	11.10	12.54	8.93
Ottawa	8.32	8.20	8.72	7.36
Montreal	9.90	9.01	10.25	6.80
Halifax	12.09	11.33	9.02	6.83
Moncton	11.21	9.64	9.13	6.37
Charlottetown	17.66	13.81	12.70	9.79
St. John's	13.19	10.92	9.88	6.41
AVERAGE	**11.66**	**9.81**	**9.96**	**7.12**

Source: Hydro Quebec, 1995 Rates Survey.
Nfld. Dept. of Natural Resources.

Table 5.2
Residential Electricity Rates Comparison
Including All Taxes
Based on 1,000 kWh Consumption
May 1, 1995

CENTRE	¢/kWh
Vancouver	6.75
Edmonton	7.64
Regina	8.71
Winnipeg	6.52
Toronto	9.96
Ottawa	7.87
Montreal	6.58
Halifax	9.90
Moncton	8.21
Charlottetown	11.66
St. John's	8.70
AVERAGE	**8.41**

Source: Hydro Quebec, 1995 Rates Survey.
Nfld. Dept. of Natural Resources.

Table 5.3

General Service Electricity Rates Comparison

Including All Taxes

¢/kWh

May 1, 1995

	SMALL		MEDIUM	LARGE
Power:	6 kW	40 kW	500 kW	1,000 kW
Consumption:	750 kWh	10,000 kWh	100,000 kWh	400,000 kWh
Load Factor:	17%	35%	28%	56%
Vancouver	8.04	7.65	6.86	5.20
Edmonton	11.51	9.49	9.27	6.80
Regina	11.51	10.09	13.36	8.68
Winnipeg	9.62	6.69	7.86	5.13
Toronto	15.23	11.10	12.54	8.93
Ottawa	8.32	8.20	8.72	7.36
Montreal	9.90	9.01	10.25	6.80
Halifax	12.09	11.33	9.02	6.83
Moncton	11.21	9.64	9.13	6.37
Charlottetown	17.66	13.81	12.70	9.79
St. John's	13.19	10.92	9.88	6.41
AVERAGE	**11.66**	**9.81**	**9.96**	**7.12**

Source: Hydro Quebec, 1995 Rates Survey.
Nfld. Dept. of Natural Resources.

Table 5.4
Industrial Electricity Rates Comparison
January 1, 1995
(20MW/12,000MWh Per Month Customer)

LOWEST TO HIGHEST	¢/kWh
Manitoba Hydro	3.06
Trans Alta Utilities	3.44
Newfoundland & Labrador Hydro	3.64
B.C Hydro	3.67
Hydro Quebec	3.97
N.B. Power	4.07
Sask. Power	4.96
Nova Scotia Power	5.45
Ontario Hydro	6.30
AVERAGE	**4.28**

Note: Includes all taxes, credits, and adjustments other than G.S.T.

Source: Newfoundland & Labrador Hydro.
Nfld. Dept. of Natural Resources.

Table 5.5
Newfoundland & Labrador Hydro Electricity Rates
Island Interconnected

	JULY 01, 1994	JULY 01, 1995
RESIDENTIAL (DOMESTIC) RATES		
Basic Monthly Customer Charge per kWh (All)	$16.71 ¢6.579	$16.73 ¢6.522
GENERAL SERVICE RATES		
Rate 2.1 (0-10 kW) Basic Monthly Customer Charge per kWh (All)	$19.02 ¢8.624	$19.04 ¢8.570
Rate 2.2 (10-100kW) per kW Demand Charge - Winter per kW Demand Charge - Summer per kWh(1st 150 kWh per kW) per kWh(Excess)	$8.16 $7.41 ¢7.177 ¢4.676	$8.17 $7.42 ¢7.121 ¢4.618
Rate 2.3 (110-1000 kVa) per kVa Demand Charge - Winter per kVa Demand Charge - Summer per kWh(1st 150 kWh per kVa to a maximum of 30,000 kWh) per kWh(Excess)	$6.79 $6.04 ¢6.583 ¢4.122	$6.80 $6.05 ¢6.527 ¢4.063
Rate 2.4 (1000 kVa and Over) per kVa Demand Charge - Winter per kVa Demand Charge - Summer per kWh(1st 100,000) per kWh(Excess)	$6.39 $5.64 ¢5.812 ¢3.985	$6.40 $5.65 ¢5.754 ¢3.925

Source: Newfoundland & Labrador Hydro.
Nfld. Dept. of Natural Resources.

Table 5.4
Industrial Electricity Rates Comparison
January 1, 1995
(20MW/12,000MWh Per Month Customer)

LOWEST TO HIGHEST	¢/kWh
Manitoba Hydro	3.06
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Newfoundland & Labrador Hydro	3.64
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Sask. Power	4.96
Nova Scotia Power	5.45
Ontario Hydro	6.30
AVERAGE	**4.28**

Note: Includes all taxes, credits, and adjustments other than G.S.T.

Source: Newfoundland & Labrador Hydro.
Nfld. Dept. of Natural Resources.

Table 5.5
Newfoundland & Labrador Hydro Electricity Rates
Island Interconnected

	JULY 01, 1994	JULY 01, 1995
RESIDENTIAL (DOMESTIC) RATES		
Basic Monthly Customer Charge	$16.71	$16.73
per kWh (All)	¢6.579	¢6.522
GENERAL SERVICE RATES		
Rate 2.1 (0-10 kW)		
Basic Monthly Customer Charge	$19.02	$19.04
per kWh (All)	¢8.624	¢8.570
Rate 2.2 (10-100kW)		
per kW Demand Charge - Winter	$8.16	$8.17
per kW Demand Charge - Summer	$7.41	$7.42
per kWh(1st 150 kWh per kW)	¢7.177	¢7.121
per kWh(Excess)	¢4.676	¢4.618
Rate 2.3 (110-1000 kVa)		
per kVa Demand Charge - Winter	$6.79	$6.80
per kVa Demand Charge - Summer	$6.04	$6.05
per kWh(1st 150 kWh per kVa to a maximum of 30,000 kWh)	¢6.583	¢6.527
per kWh(Excess)	¢4.122	¢4.063
Rate 2.4 (1000 kVa and Over)		
per kVa Demand Charge - Winter	$6.39	$6.40
per kVa Demand Charge - Summer	$5.64	$5.65
per kWh(1st 100,000)	¢5.812	¢5.754
per kWh(Excess)	¢3.985	¢3.925

Source: Newfoundland & Labrador Hydro.
Nfld. Dept. of Natural Resources.

Table 5.6
Newfoundland & Labrador Hydro Electricity Rates
Labrador Interconnected
Happy Valley/Goose Bay and Northwest River

	JULY 01, 1994	JULY 01, 1995
RESIDENTIAL (DOMESTIC) RATES		
Basic Monthly Customer Charge per kWh(1st 600) per kWh(Excess)	$6.00 ¢4.100 ¢3.300	$6.00 ¢4.100 ¢3.300
GENERAL SERVICE RATES		
Rate 2.1A (0-10kW) Basic Customer Charge per kWh(All)	$9.10 ¢5.400	$9.10 ¢5.400
Rate 2.2A (10-100kW) per kW Demand Charge per kWh(1st 100 kWh per kW) per kWh(Excess)	$3.85 ¢5.600 ¢2.900	$3.85 ¢5.600 ¢2.900
Rate 2.3A (110kVa and Over) per kVa Demand Charge per kWh(1st 150 kWh per kVa to a maximum of 90,000 kWh) per kWh(Excess)	$3.50 ¢3.750 ¢2.100	$3.50 ¢3.750 ¢2.100
Rate 3.1A (Electric Heating) per kVa Demand Charge per kWh(All)	$2.35 ¢2.100	$2.35 ¢2.100
Rate 3.2A (All-Electric) per kVa Demand Charge per kWh(1st 120 kWh per kVa to a maximum of 22,000 kWh) per kWh(Excess)	$3.50 ¢3.700 ¢2.100	$3.50 ¢3.700 ¢2.100

Source: Newfoundland & Labrador Hydro.
Nfld. Dept. of Natural Resources.

Table 5.7
Newfoundland & Labrador Hydro Electricity Rates
Labrador Interconnected
Wabush

	JULY 01, 1994	JULY 01,1995
RESIDENTIAL (DOMESTIC) RATES		
Wabush (New Structure) Basic Monthly Customer Charge per kWh(All)	$2.42 ¢1.318	$2.42 ¢1.318
GENERAL SERVICE RATES		
Wabush (New Structure) Rate 2.1 (0-10kW) per kW Demand Charge per kWh(1st 150 kWh per kW) per kWh(Excess)	 $1.333 ¢4.309 ¢1.333	 $1.333 ¢4.309 ¢1.333
Rate 2.2 (10kW and Over -Single Phase) per kW Demand Charge per kWh(1st 150 kWh per kW) per kWh(Excess)	 $1.333 ¢4.335 ¢1.333	 $1.333 ¢4.335 ¢1.333
Rate 2.2A (10-100kW - Three Phase) per kW Demand Charge per kWh(1st 150 kWh per kW) per kWh(Excess)	 $2.19 ¢2.402 ¢1.333	 $2.19 ¢2.402 ¢1.333
Rate 2.3 (100kW and Over -Three Phase) per kW Demand Charge per kWh(1st 150 kWh per kW) per kWh(Excess)	 $2.19 ¢2.402 ¢1.333	 $2.19 ¢2.402 ¢1.333
Rate 3.2 (All-Electric - Single Phase per kW Demand Charge per kWh(1st 150 kWh per kW) per kWh(Excess)	 $1.33 ¢4.324 ¢1.333	 $1.33 ¢4.324 ¢1.333
Rate 3.2A (0-100kW All-Elect.-3 Phase) per kW Demand Charge per kWh(1st 150 kWh per kW) per kWh(Excess)	 $2.19 ¢2.402 ¢1.333	 $2.19 ¢2.402 ¢1.333
Rate 3.3 (100kW & Over All-Elect.-3 Phase) per kW Demand Charge per kWh(1st 150 kWh per kW) per kWh(Excess)	 $2.19 ¢2.402 ¢1.333	 $2.19 ¢2.402 ¢1.333

Source: Newfoundland & Labrador Hydro.
Nfld. Dept. of Natural Resources.

Table 5.8
Newfoundland & Labrador Hydro Electricity Rates
Labrador Interconnected
Labrador City

	JULY 01, 1994	JULY 01, 1995
RESIDENTIAL (DOMESTIC) RATES		
Labrador City		
Basic Monthly Customer Charge	N/A	N/A
per kWh(0-20)	$1.15	$1.15
per kWh(21-60)	¢2.780	¢2.780
per kWh(61-300)	¢1.270	¢1.270
per kWh(Excess)	¢1.150	¢1.150
GENERAL SERVICE RATES		
Labrador City		
Rate 2.2 (Single Phase)		
Basic Monthly Customer Charge	N/A	N/A
per kW Demand Charge	$1.15	$1.15
per kWh(1st 10 kWh)	FREE	FREE
per kWh(Next 90 kWh)	¢4.620	¢4.620
per kWh(Next 50 kWh)	¢2.890	¢2.890
per kWh(Excess)	¢1.150	¢1.150
Rate 2.3 (Three Phase)		
Basic Monthly Customer Charge	N/A	N/A
per kW Demand Charge	$1.90	$1.90
per kWh(1st 40 kWh per kW)	¢4.620	¢4.620
per kWh(Excess)	¢1.150	¢1.150

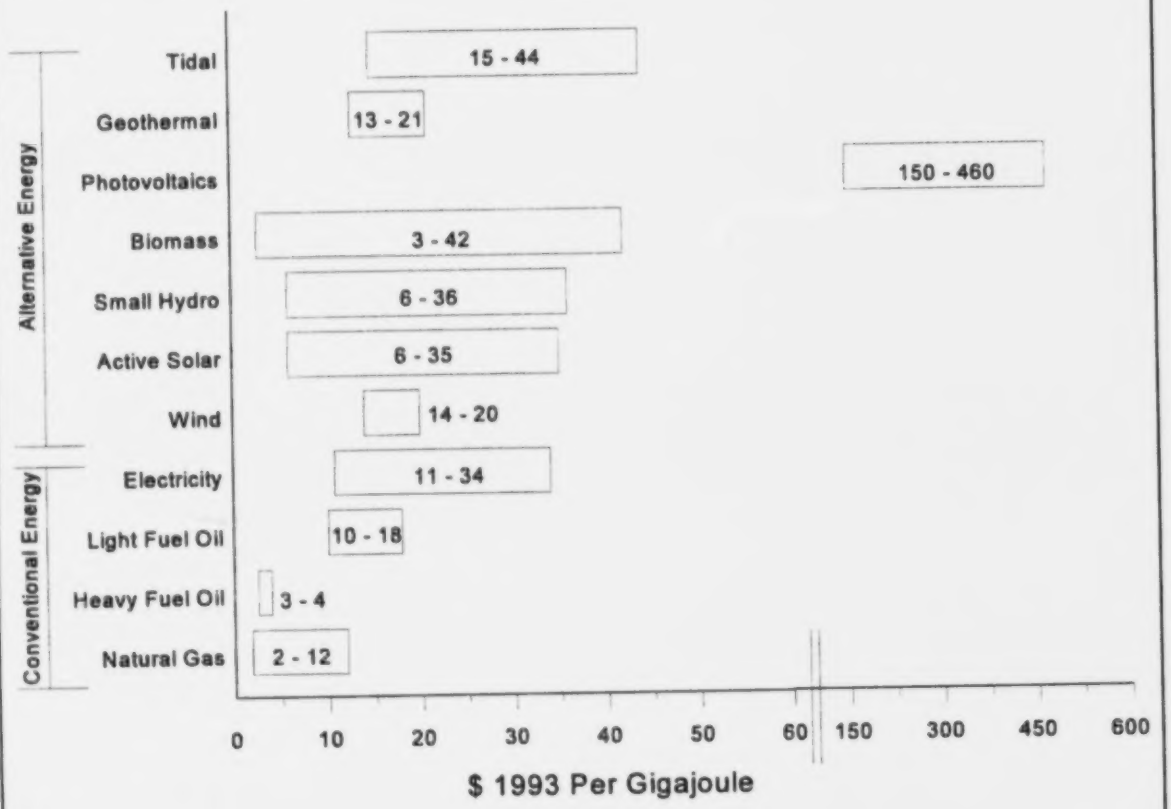
Source: Newfoundland & Labrador Hydro.
Nfld. Dept. of Natural Resources.

Table 5.9
Newfoundland & Labrador Hydro Electricity Rates
Island and Labrador Non Interconnected
Rural and Isolated Diesel

	July 01, 1994	July 01, 1995
Residential (Domestic) Rates		
Isolated/Diesel		
Basic Monthly Customer Charge	$16.71	$16.73
per kWh(1st 700)	¢6.579	¢6.522
per kWh(Next 300)	¢9.606	¢9.606
per kWh(Excess)	¢13.022	¢13.022
General service rates		
Isolated/Diesel		
Rate 2.5		
Basic Monthly Customer Charge	$19.02	$19.04
per kWh(1st 700)	¢8.624	¢8.570
per kWh(Excess)	¢19.540	¢19.540

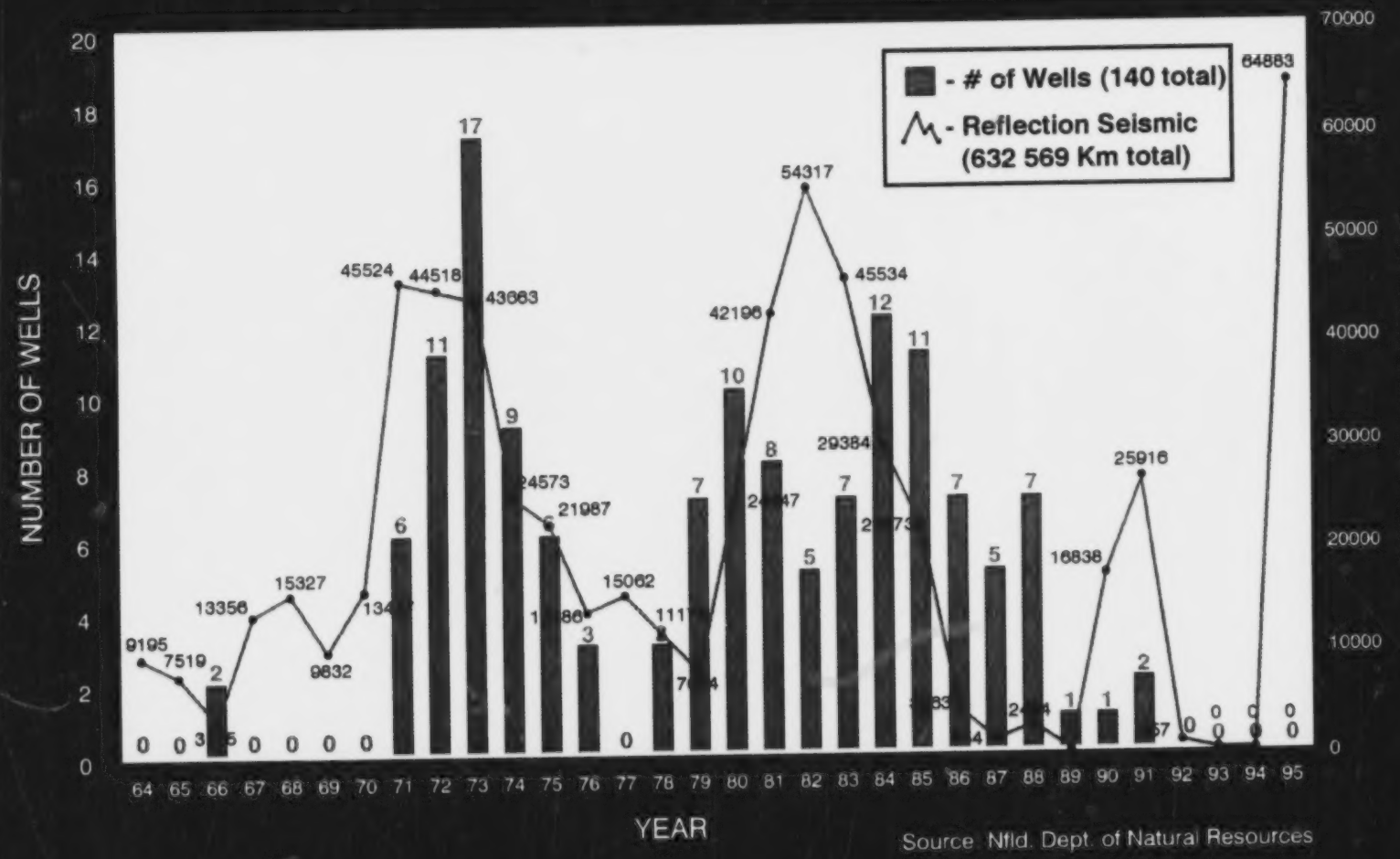
Source: Newfoundland & Labrador Hydro.
Nfld. Dept. of Natural Resources.

Figure 5.4
Comparison Between End Use Alternative Energy Supply Costs and Conventional Energy Price



Source: National Energy Board, Canadian Energy Supply and Demand 1993-2010

Figure 6.1
Wells Spudded / Reflection Seismic Statistics
Offshore Newfoundland and Labrador
1964 - 1995



Source: Nfld. Dept. of Natural Resources

Figure 6.1
Wells Spudded / Reflection Seismic Statistics
Offshore Newfoundland and Labrador
1964 - 1995

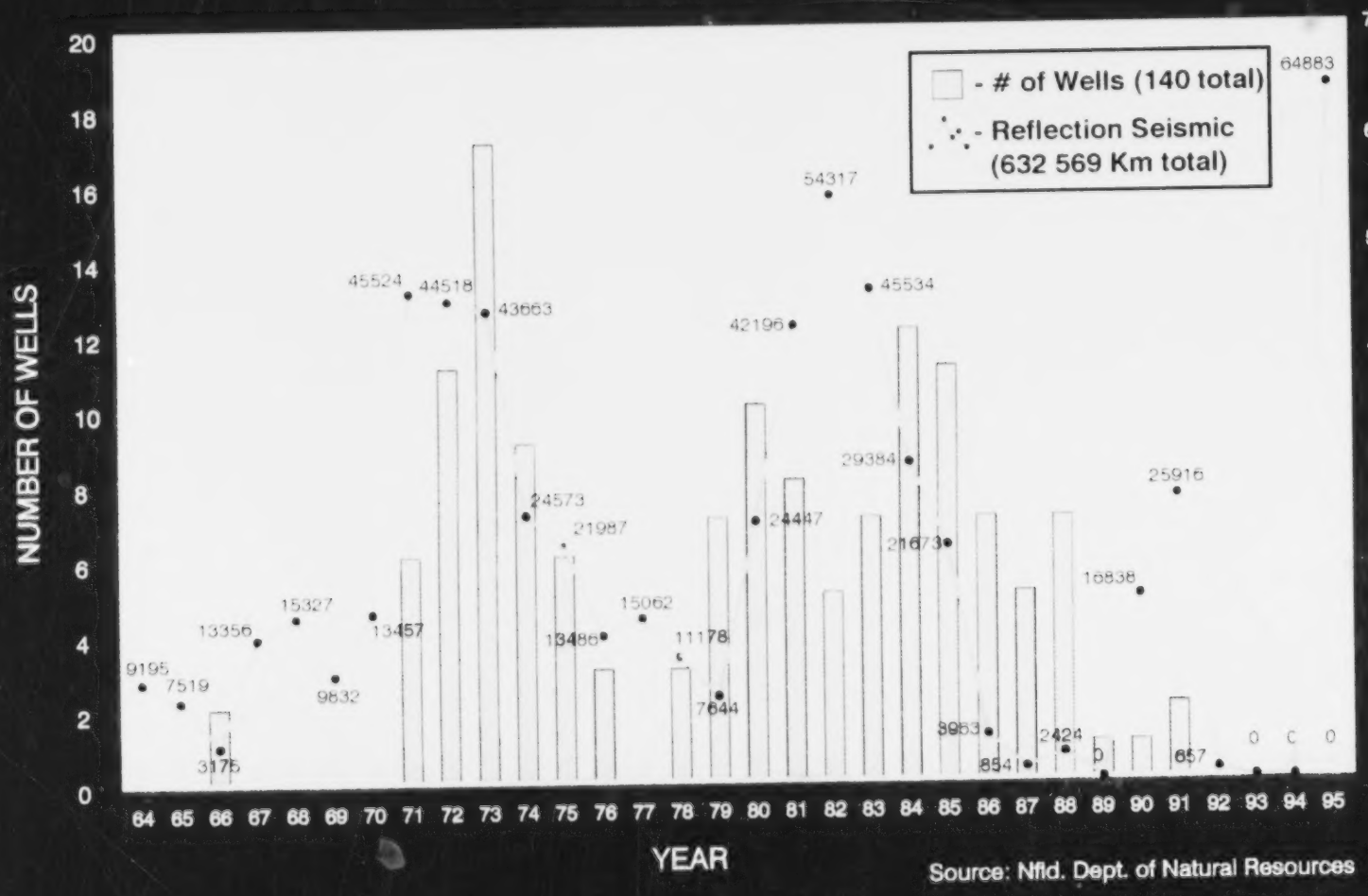


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Table 6.1
Significant Hydrocarbon Discoveries
Newfoundland Offshore

FIELD	OIL [1] (MMSTB)	GAS [1] (BSCF)	NGL's (MMSTB)
GRAND BANKS			
HIBERNIA	666	1,017	111
TERRA NOVA	406	269	14
HEBRON	195	-	-
WHITEROSE	178	1,509	58
WEST BEN NEVIS	25	-	-
MARA	23	-	-
BEN NEVIS	19	229	30
NORTH BEN NEVIS	18	115	64
SPRINGDALE	14	236	-
NAUTILUS	13	-	-
SOUTH TEMPEST	8	-	-
EAST RANKIN	7	-	-
FORTUNE	6	-	-
SOUTH MARA	4	144	8
NORTH DANA	0	470	11
TRAVE	0	30	1
SUBTOTAL	1,582	4,019	237
LABRADOR			
NORTH BJARNI	0	2,235	82
GUDRID	0	920	6
BJARNI	0	859	31
HOPEDALE	0	105	2
SNORRI	0	105	2
SUBTOTAL	0	4,224	123
TOTAL	**1,582**	**8,243**	**360**

1. Expressed at the 50% Probability of Occurrence.

Source: CNOPB - Annual Report, 1994-95.

Table 6.2
Newfoundland Offshore Land Holdings
March 31, 1995

Interest Owner's/ Representative	EL's		SDL's		PL's[1]		Total
Mobil Oil Canada	2	482,400	7	35,962	1	22,285	540,647
Labrador Group	-	0	4	25,185	-	0	25,185
Petro-Canada	1	13,172	10	28,416	-	0	41,588
Shell Canada	2	241,783	-	0	-	0	241,783
Husky Oil	-	0	20	58,746	-	0	58,746
Imperial Oil	-	0	4	5,691	-	0	5,691
St. Georges Bay	1	178,460	-	0	-	0	178,460
Hunt Oil	2	521,170	-	0	-	0	521,170
BHP Petroleum	1	257,885	-	0	-	0	257,885
Labrador Mining	2	468,195	-	0	-	0	468,195
Amoco Canada	2	104,234	-	0	-	0	104,234
TOTAL	**13**	**2,267,299**	**45**	**154,000**	**1**	**22,285**	**2,443,584**

1. Hibernia.

Source: Nfld. Dept. of Natural Resources.

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Newfoundland Offshore

FIELD	OIL [1] (MMSTB)	GAS [1] (BSCF)	NGL's (MMSTB)
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WEST BEN NEVIS	25	-	-
MARA	23	-	-
BEN NEVIS	19	229	30
NORTH BEN NEVIS	18	115	64
SPRINGDALE	14	236	-
NAUTILUS	13	-	-
SOUTH TEMPEST	8	-	-
EAST RANKIN	7	-	-
FORTUNE	6	-	-
SOUTH MARA	4	144	8
NORTH DANA	0	470	11
TRAVE	0	30	1
SUBTOTAL	1,582	4,019	237
LABRADOR			
NORTH BJARNI	0	2,235	82
GUDRID	0	920	6
BJARNI	0	859	31
HOPEDALE	0	105	2
SNORRI	0	105	2
SUBTOTAL	0	4,224	123
TOTAL	**1,582**	**8,243**	**360**

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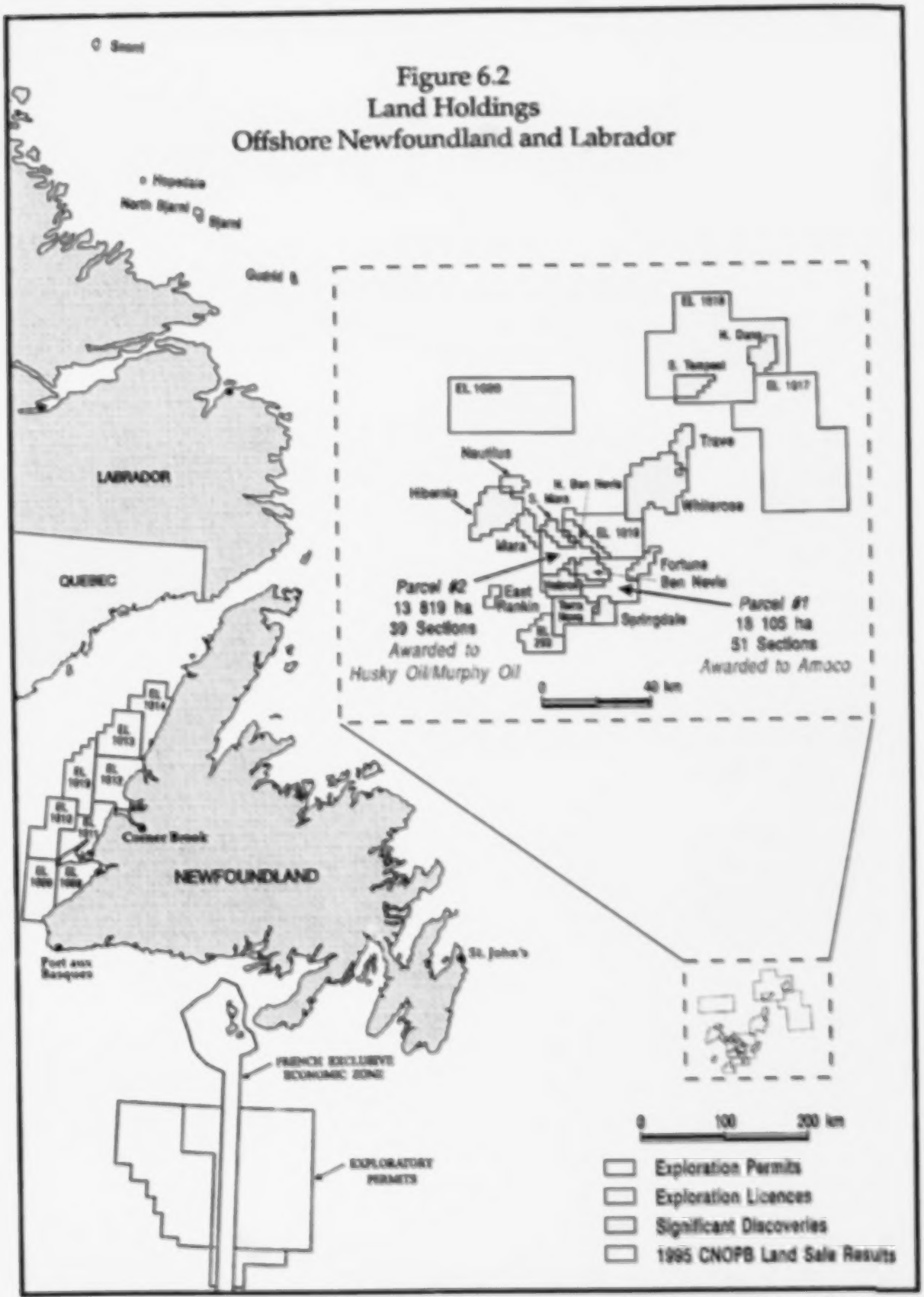
Labrador Group	-	0	4	25,185	-	0	25,185
Petro-Canada	1	13,172	10	28,416	-	0	41,588
Shell Canada	2	241,783	-	0	-	0	241,783
Husky Oil	-	0	20	58,746	-	0	58,746
Imperial Oil	-	0	4	5,691	-	0	5,691
St. Georges Bay	1	178,460	-	0	-	0	178,460
Hunt Oil	2	521,170	-	0	-	0	521,170
BHP Petroleum	1	257,885	-	0	-	0	257,885
Labrador Mining	2	468,195	-	0	-	0	468,195
Amoco Canada	2	104,234	-	0	-	0	104,234
TOTAL	**13**	**2,267,299**	**45**	**154,000**	**1**	**22,285**	**2,443,584**

1. Hibernia.

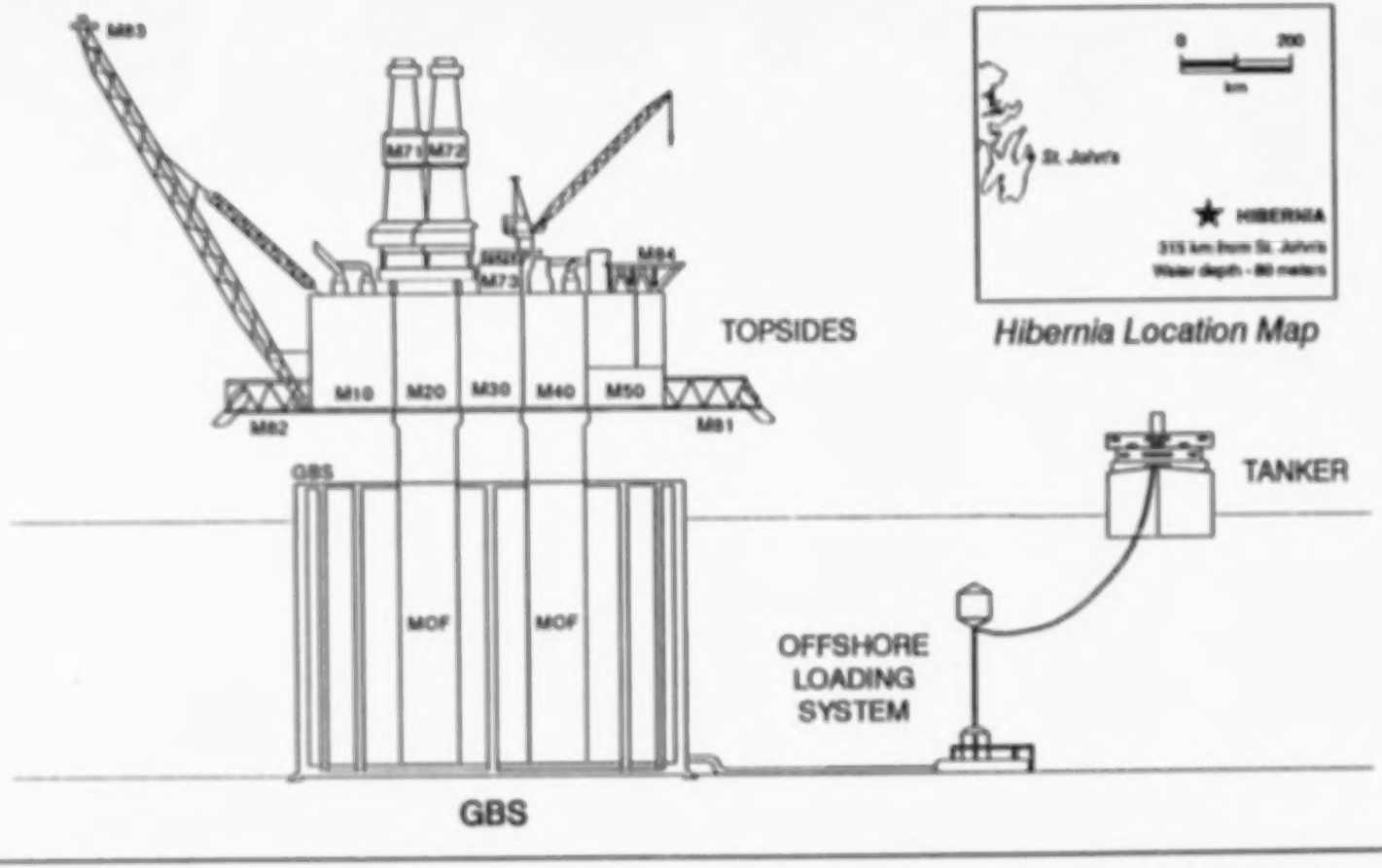
Source: Nfld. Dept. of Natural Resources.

Figure 6.2
Land Holdings
Offshore Newfoundland and Labrador



Source: Nfld. Dept. of Natural Resources

Figure 6.3
Hibernia Production System Components



Source: Nfld. Dept. of Natural Resources

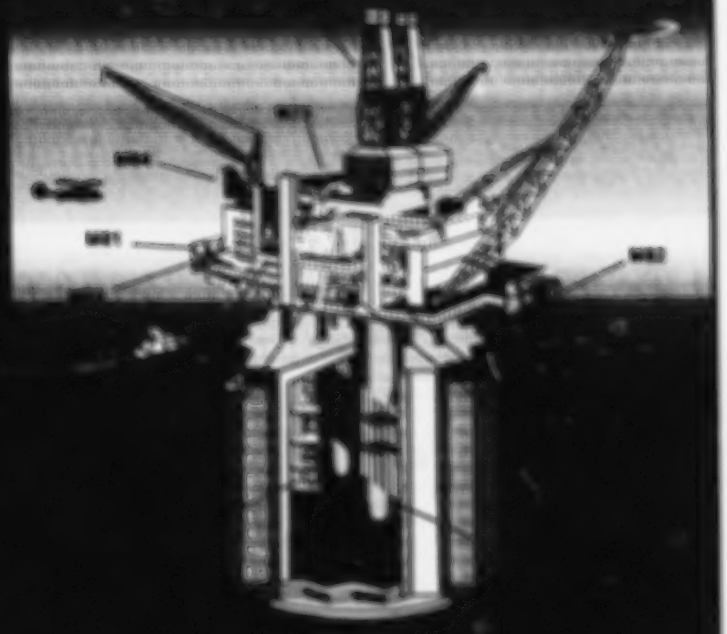
Table 6.3
Hibernia Development Project
Select Platform Specifications

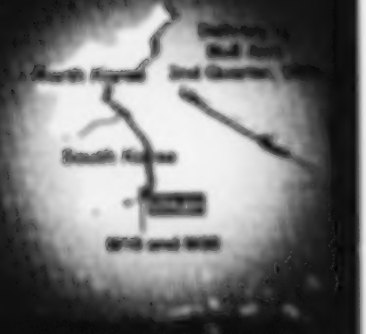
Total Height	224 metres
Total Weight	600,000 tonnes under tow: 1.2 million tonnes after ballasting
Height of Caisson	85 metres
Height of Shafts	26 metres
Height of GBS	111 metres
Diameter of GBS	106 metres
GBS Concrete	450,000 tonnes
GBS Reinforcing Steel	70,000 tonnes
Storage	1.3 million barrels of oil
Design Production Capacity	150,000 barrels per day

Source: Nfld. Dept. of Natural Resources.

Figure 6.4
Hibernia Construction Activity

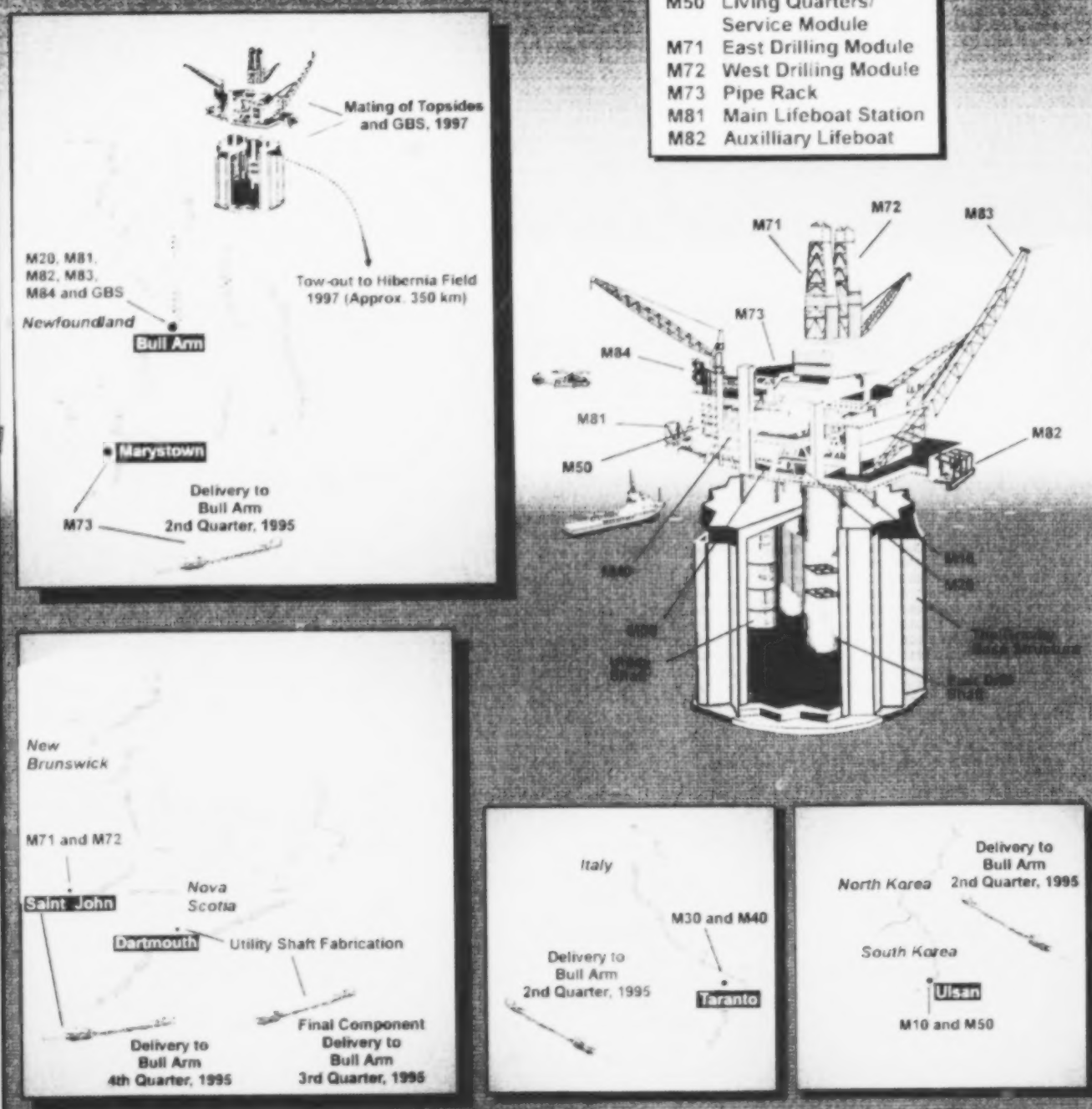
M10	Process Module
M20	Wellhead Module
M30	Mud Module
M40	Utility Module
M50	Living Quarters/ Service Module
M71	East Drilling Module
M72	West Drilling Module
M73	Pipe Rack
M81	Main Lifeboat Station
M82	Auxiliary Lifeboat





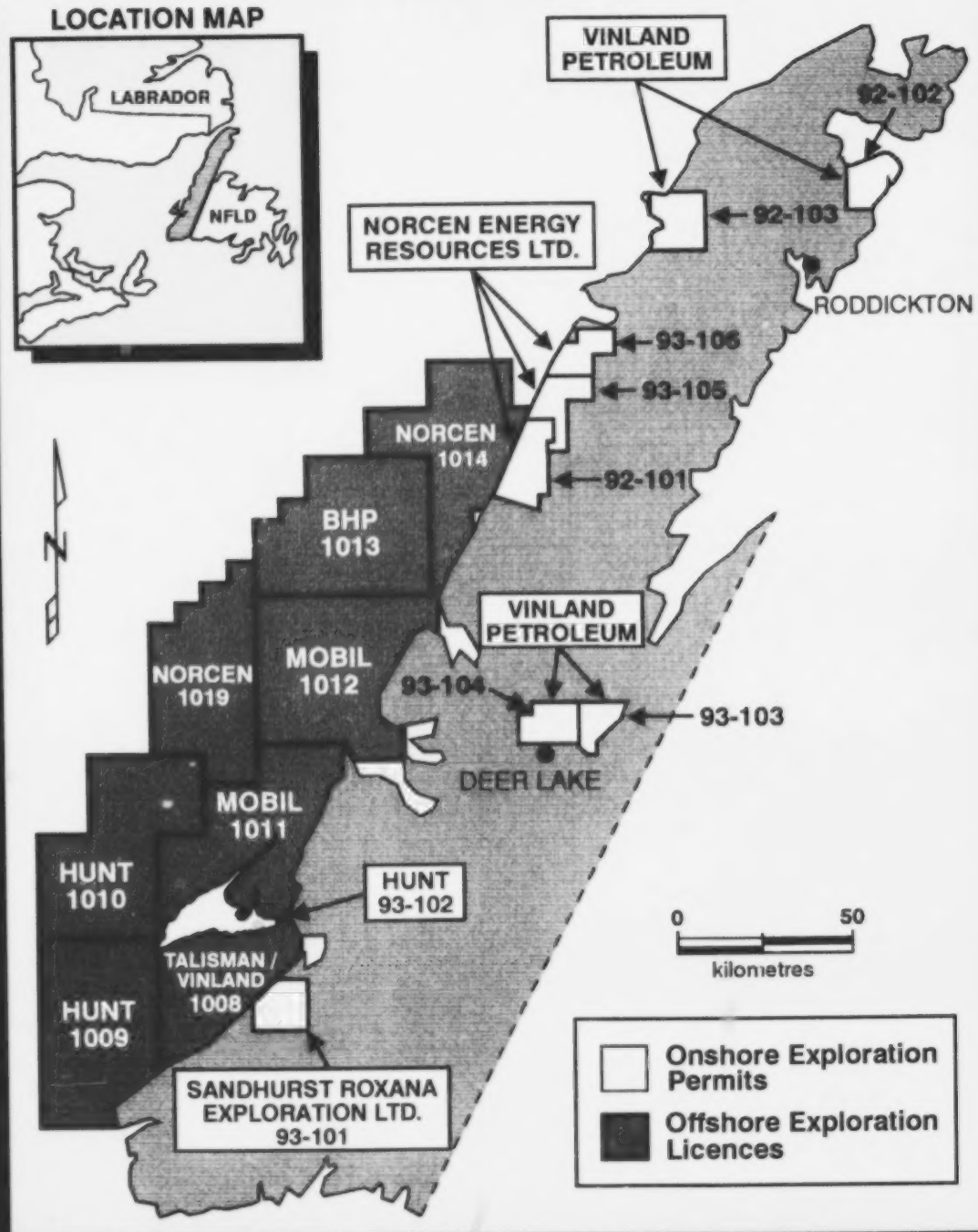
Source: Hibernia Management and Development Company Ltd.; Economics and Statistics Section, Cabinet Secretariat

Figure 6.4
Hibernia Construction Activity



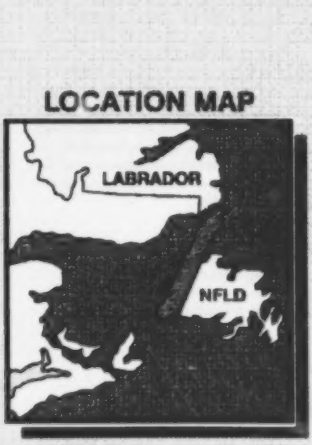
Source: Hibernia Management and Development Company Ltd.; Economics and Statistics Section, Cabinet Secretariat.

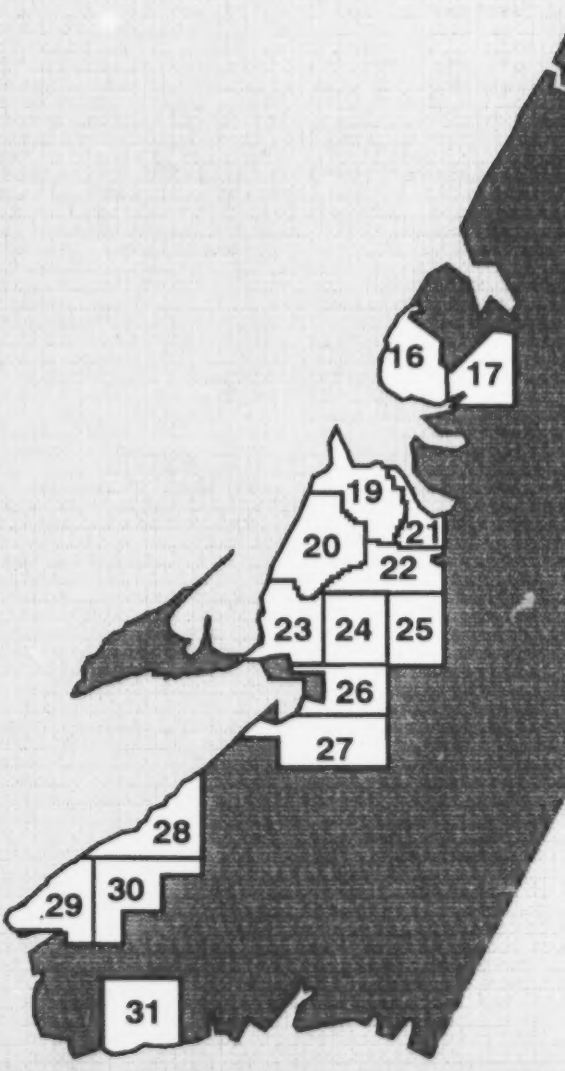
Figure 6.5
Western Newfoundland
Petroleum Rights
October, 1995



Source: Nfld Dept. of Natural Resources

Figure
Western New
Request fo
Novembe





6.6
oundland
r Bids
, 1995

Source: Nfld Dept. of Natural Resources

Table
Petroleum Rights Issu
Newfoundland a

ONSHORE	
Call for Postings	**Step**
Industry is requested to identify (post) land parcels to become available for bidding.	
Evaluation	**Step**
Posted land parcels are evaluated by the Dept. of Natural Resources to decide which parcels will be offered for bidding.	
Call for Bids	**Step**
Selected land parcels are opened for bidding.	
Issuance of Exploration Permits	**Step**
Successful bidders are issued exploration permits.	

[1] Exploratory seismic is normally acquired foll
of seismic data.

Source: Cana
Econ
Cabi
Reso

.4
nce Procedures [1]
d Labrador

OFFSHORE	
1	**Call for Nominations**
	Industry is requested to identify (nominate) land parcels to become available for bidding.
2	**Evaluation**
	Nominated land parcels are evaluated by the Canada-Newfoundland Offshore Petroleum Board (C-NOPB) to decide which parcels will be offered for bidding.
3	**Call for Bids**
	Selected land parcels are opened for bidding.
4	**Issuance of Exploration Licences**
	Successful bidders are issued exploration licences.

wing Step 4. Drilling may follow the acquisition

a-Newfoundland Offshore Petroleum Board;
mic Research and Analysis Division,
et Secretariat; Department of Natural
rces.

APPENDIX I: GLOS

The attached glossary has been ex
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APPENDIX I: GLOSSARY

GLOSSARY

Acid Rain	Rain water that is acidified by sulphuric, nitric, organic, or other acids.
Alternative Energy	Refers to non-conventional energy sources such as wood, wood waste, municipal solid waste, small scale hydro, peat, tidal, geothermal, photovoltaics, and solar.
API	American Petroleum Institute scale that measures the relative density of crude oil and oil products.
Biomass	Organic material such as wood, crop waste, municipal solid waste and mill waste, processed for energy production.
BOE	Barrels of oil equivalent.
Btu	British thermal unit. The amount of heat required to raise the temperature of 1 pound of water by 1° Fahrenheit.
Capacity (electricity)	The maximum amount of power which a machine, apparatus or appliance can generate, utilize or transfer, expressed in kilowatts or some multiple thereof.
Co-generation	A facility which produces steam heat as well as electricity, with a resultant overall improvement in energy conversion efficiency.
Conventional Crude Oil	Crude oil which at a particular point in time can be technically and economically produced through a well using normal production practices and without altering the natural viscous state of the oil.
CNOPB	Canada-Newfoundland Offshore Petroleum Board; responsible for the management of Newfoundland's offshore oil and gas resources.
DWS	Deepwater construction site.

GLOSSARY (Cont'd)

Degree Day (or Heating Degree Day)	A (heating) degree day is a measure of the extent to which the average daily temperature is below 18°C. For example, if the average daily temperature were 16°C for a given location for a ten day period, the number of degree days recorded would be twenty. For days when the average temperature is warmer than 18°C, the degree days are recorded as zero. Degree days are used to indicate the amount of space heating required, other things being equal; for example, the higher the number of degree days, the colder the average recorded temperatures and the more space heating required.
Demand Side Management	Measures promoted by electric and natural gas utilities to favourably influence the amount and timing of customer energy demand.
Discovered Recoverable Resources	Resources which are estimated at this time to be recoverable from known accumulations (i.e., accumulations which have been shown to exist by drilling, testing or production) using known technology. They include cumulative production, remaining reserves and "other discovered recoverable resources".
EL's	Exploration Licences.
Electricity Production	The amount of electric energy expressed in kilowatt hours or multiples of kilowatt hours produced in a year. The determination of electric energy production takes into account various factors such as the type of service for which generating units were designed (e.g., peaking or base load), the availability of fuels, the cost of fuels, stream flows and reservoir water levels, and environmental constraints.
Emission Factor	An estimate of the rate at which a substance is released to the atmosphere as a result of some activity (e.g., kilograms of sulphur dioxide emitted per tonne of coal burned).

GLOSSARY (Cont'd)

Energy Intensity	In the industrial and commercial sectors and in transportation other than automobiles, energy intensity is defined as the amount of energy used per unit of production. In the residential sector it is energy use per household and for automobiles it is the average fuel economy of the car stock. A measure of the intensity with which energy is used in the economy as a whole is total end use energy per unit of real GDP.
EPCA	The Electrical Power Control Act is a provincial act that controls the rates of Newfoundland and Labrador Hydro and establishes the provincial power policy.
Established Reserves (Oil and Gas)	Those reserves recoverable under current technology and present and anticipated economic conditions, specifically those proved by drilling, testing or production ("proved reserves"), plus that judgement portion of continuous recoverable reserves that is interpreted to exist, from geological, geophysical or similar information, with reasonable certainty ("probably reserves"). Established reserves are typically comprised of proved reserves plus one-half probable reserves.
Feedstock	Raw material (i.e., crude oil) supplied to a refinery.
Fossil Fuels	Hydrocarbon based fuel sources such as coal, natural gas and oil that are the by-product of the decay of ancient plants and animals whose remains are converted under great pressure in the Earth's crust over very long periods of time.
Gas Plant NGL's	Gas plant natural gas liquids. Classification of fuel types employed by Statistics Canada to include propane, butane and ethane.
GBS	Gravity Based Structure.
GDP	Gross Domestic Product; the value of all goods and services produced in the economy.

GLOSSARY (Cont'd)

Greenhouse Effect	A naturally occurring phenomenon in the earth's atmosphere in which incoming solar short-wave radiation emitted from the warm surface of the earth is partially absorbed, adding net energy to the lower atmosphere and underlying surface, thereby increasing their temperature. The greenhouse effect is enhanced by the addition to the atmosphere of several trace gases. This phenomena is analogous to the way in which heat is trapped by the glass in a greenhouse.
Heavy Fuel Oil	In this report, includes bunker fuel oils (No.5 and No. 6 fuel oils) and industrial fuel oil (No. 4 fuel oil).
Hydroelectric Generation	Electricity produced by an electric generator driven by a hydraulic turbine.
KPMG	Peat Marwick Stevenson & Kellogg Management Consultants.
Light Crude Oil	A term applied to crude oil having a low density.
Light Fuel Oil	Furnace fuel oil (No. 2 fuel oil).
Load	The amount of electric power or energy consumed by a particular customer or group of customers.
Load Factor	The ratio of the average load during a designated period to the peak or maximum load during that same period (usually expressed as a percent).
NGL's	Natural Gas Liquids
NLH	Newfoundland and Labrador Hydro. A Newfoundland crown utility.
Nitrogen Oxides	The primary nitrogen by-products of combustion are nitrogen oxide (NO) and nitric dioxide (NO_2) which are collectively known as nitrogen oxides (NO_x). NO_x contribute to the formation of acid rain and are important in the production of ozone in the lower atmosphere.
Nitrous Oxide	A chemical active trace gas which has a large number of natural sources and is a secondary product of combustion. Nitrous oxide is a strong greenhouse gas.

GLOSSARY (Cont'd)

Non-Utility Generation	Non-utility owned electric power facilities built, owned and operated by specific industries or private investors to serve the industry's own electricity needs or to serve the electric utility load requirement.
NP	Newfoundland Power. A Newfoundland investor-owned utility.
OECD	The Organization for Economic Co-operation and Development.
Petroleum	A naturally occurring mixture of predominantly hydrocarbons in the gaseous, liquid or solid phase.
Photovoltaics	Photovoltaic systems produce direct-current electric power from solar energy, using semiconductor materials.
PL's	Production Licences.
Primary Energy Demand	Represents the total requirement for all uses of energy, including energy used by the final consumer, intermediate uses of energy in transforming one energy form to another (e.g., oil to electricity), and energy used by suppliers in providing energy to the market (e.g., pipeline fuel).
Propane	In addition to its normal scientific meaning, a mixture mainly of propane which ordinarily may contain some ethane or butane.
PUB	The Board of Commissioner's of Public Utilities of the Province of Newfoundland is the regulatory body for electrical utilities under provincial jurisdiction.
Real Energy Price	The price of an energy source after adjusting for inflation in the general price level. In this report real energy prices are expressed in 1994 constant dollars (U.S.).
R-2000 Homes	A designation, established in 1980 by Energy, Mines and Resources Canada (now Natural Resources Canada), for homes characterized by high levels of insulation, control of air leakage by means of improved air barrier sealing techniques, mechanical ventilation systems (often coupled with heat recovery), improved heating systems, and utilization of passive solar energy.

GLOSSARY (Cont'd)

SDL's	Significant Discovery Licences.
Secondary Energy Demand	Energy used by final consumers for residential, commercial, industrial and transportation purposes, and hydrocarbons used for such non-energy purposes as petrochemical feedstock.
Solar Energy - Active System	Solar energy collection system which transfers heat captured from solar radiation through mechanical devices.
Solar Energy - Passive System	Solar energy collection system which captures solar radiation directly for space heating, water heating or other similar purposes, without the use of mechanical devices.
Sulphur Dioxide	Refers to gaseous sulphur dioxide (SO_2). In some cases, emissions may contain small amount of sulphur trioxide (SO_3) and sulphurous and sulphuric acid vapour. Excludes particulate or aerosol sulphate.
Thermal Generation	Energy conversion in which fuel is consumed to generate heat energy which is converted to mechanical energy and then to electricity. Normally, the fuel may be coal, gas, fuel oils, biomass or uranium (nuclear).
TMS	Topsides mounted structure.
TOE	Tonnes of oil equivalent.
Ultimate Recoverable Resource Potential	An estimate, at a given point in time, of all the resources that may become recoverable or marketable, having regard for the geological prospects and anticipated technology. It consists of cumulative production, remaining established reserves, other discovered resources and undiscovered recoverable resources.
Wood Waste	Fuel consisting of bark, shavings, sawdust and low grade lumber and lumber rejects from the operation of pulp mills, sawmills and plywood mills.

APPENDIX II: ENERGY EQUIVALENTS & CONVERSION FACTORS

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GENERAL:		
1 calorie (cal)		= 4.196 joules (J)
1 J		= 0.239 Cal
1000 J		= 1 kilojoule (KJ)
		= .948 British Thermal Units (Btu)
1000 KJ		= 1 megajoule (MJ)
1000 MJ		= 1 gigajoule (GJ)
1000 GJ		= 1 terajoule (TJ)
1000 TJ		= 1 petajoule (PJ)
PETROLEUM:		
1 Barrel of Oil		= .136 tonnes
		= .1590 m^3
1 Tonne of Oil		= 7.33 Barrels
		= 1.17 m^3
1m^3		= 6.29 Barrels
1m^3	- Natural Gas	= .0372 GJ
	- Crude Oil	
	· Light	= 38.51 GJ
	· Heavy	= 40.90 GJ
	- Products	
	· Aviation Gasoline	= 33.52 GJ
	· Aviation Turbo Fuel	= 35.93 GJ
	· Kerosene	= 37.68 GJ
	· Diesel	= 38.68 GJ
	· Light Fuel Oil	= 38.68 GJ
	· Heavy Fuel Oil[1]	= 41.73 GJ
	· Motor Gasoline	= 34.66 GJ
ELECTRICITY:		
1 GJ		= 277.8 kWh
COAL:		
1 Tonne	- Anthracite	= 27.7 GJ
		= .667 TOE
	- Lignite	= 14.4 GJ
		= .333 TOE
FUEL WOOD (soft/hard, 70/30 with 30% moisture):		
1 Cord (solid)		= 2.4m^3
		= 20.77 GJ
		= 3.2 BOE

1. When converting from Petroleum Products to electricity it is typical to assume a plant efficiency in the order of 33%. For example, 1 PJ of electricity =6.29/41.73*1x10^{6}GJ =150,781 barrels of heavy fuel oil. However, with a plant efficiency of 33%, 150,781/.33 = 456,912 barrels would be required to actually produce 1 PJ of electricity.

Source: Nfld. Dept. of Natural Resources.

APPENDIX III: CONTACT PERSONS - NFLD. DEPT. OF NATURAL RESOURCES

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